Carl Ely

316 Huntington Ave.

Brooklyn

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Association Institute Bulletin
Polytechnic School

1910-11

TRAINING FOR SERVICE

Y.M.C.A.

TENEO ET TENEOR

Co-Operative Engineering Courses

PUBLISHED SEMI-MONTHLY APRIL TO AUGUST
By

The Boston Young Men's Christian Association

2, 8 & 10 ASHBURTON PLACE, BOSTON, MASS.

Entered as second-class matter, May 28, 1909 at the Post Office at Boston, Mass. under the Act of July 16, 1894.

CALENDAR

1910-1911

July 11	Practical work commences.
September 26.	School work commences.
November 24.	Thanksgiving Day, Holiday
December 24-January 2.	Christmas Recess.
February 22.	Washington's Birthday, Holiday.
April 19.	Patriots' Day, Holiday.
May 30.	Decoration Day, Holiday.
June 15.	School year ends.

EDUCATIONAL COMMITTEE

D. Chauncey Brewer, Chairman

William E. Murdock — John Shepard

Albert H. Curtis — John E. Rousmaniere

OFFICERS OF ADMINISTRATION

Arthur S. Johnson, President.
George W. Mehaffey, General Secretary.
Frank P. Speare, Educational Director.
Galen D. Light, A.B., Asst. Educational Director and Bursar.
Hercules W. Geromanos, S.B., Dean.

ADVISORY BOARDS

Architecture

Charles H. Rutan, Shepley, Rutan & Coolidge
Ira G. Hersey, President of the Master Builders' Association
Henry H. Kendall, Kendall, Taylor & Stevens

Chemistry

Henry P. Talbot, Professor of Chemistry, Massachusetts Institute of Technology
Arthur D. Little, Consulting Chemist

Mathematics

Prof. B. C. Pierce, and Prof. H. E. Clifford, of Harvard University
Prof. F. H. Bailey, Massachusetts Institute of Technology

Mechanical Engineering

Prof. Gaetano Lanza, C. E., Head of the Department of Mechanical Engineering, Massachusetts Institute of Technology
Howard L. Coburn, S.B., Mechanical Engineer

Structural Engineering

George F. Swain, Professor Civil Engineering, Harvard University
J. Parker Snow, Bridge Engineer, Boston & Maine Railroad
Maurice F. Brown, Chief Engineer, Boston Bridge Works

Surveying

Dwight Porter, Professor of Hydraulic Engineering, Massachusetts Institute of Technology

Frank W. Hodgdon, Chief Engineer, Harbor and Land Commission of Massachusetts

Henry Manley, Assistant Engineer, Engineering Department of City of Boston

Railroad Engineering

Frank B. Rowell, Assistant Chief Engineer, B. & M. R. R.
Edwin P. Dawley, Engineer of Construction, N. Y., N. H. & H. R. R.
Wm. Parker, Principal Assistant Engineer, B. & A. R. R.

FACULTY

Henry B. Alvord, S.B., Railroad Engineering
Royall D. Bradbury, S.B., Concrete Engineering
Charles B. Breed, S.B., Railroad Engineering
James Brough, Freehand Drawing and Industrial Design
Harry P. Cromwell, Mechanical Drawing
Clarence E. Ebert, Mathematics
Arthur E. French, Architecture
Hercules W. Geromanos, S.B., Physics and Chemistry
Harold S. Graves, Mechanical Drawing
F. C. Hosmer, English
George L. Hosmer, Surveying
John W. Howard, S.B., Surveying
J. R. Hugelmann, Mechanics and Descriptive Geometry
Stroud Jordan, A.B., Ph.D., Chemistry
Daniel Knowlton, S.B., Estimating
Franklin T. Kurt, Ph.B., Physics and Chemistry
Howard B. Luther, S.B., Surveying
Charles H. B. Morse, Illustrating and Cartooning
Thomas E. Penard, S.B., Mathematics
Elwood B. Spear, A.B., Ph.D., Chemistry
George W. Swett, S.B., Mechanism
George A. Truelson, Architecture
Albert E. West, Architecture and Structural Steel
Marion E. Jones, S.B., Secretary Association Institute
Katherine M. Vinton, Secretary to the Educational Director

BULLETIN OF THE CO-OPERATIVE ENGINEERING SCHOOL

The Need of Such a School

When a boy is graduated from a high school he has two roads from which to choose, one leads to a higher institution of learning, the other, which is taken by far the greater number, leads to business pursuits.

But the boy entering business after a high school career, is at once confronted by the fact that, while his education has broadened his view and given him general culture, it has not fitted him for any specific position in any particular line, or occupation. Consequently, he must begin work at the bottom of the ladder, and it may be years before he mounts even a few of the rounds. After being at work for a time, the ambitious young man sees that if he is going to get ahead at all, he must know more of those subjects which bear directly upon his occupation. This necessity has brought to the Evening Schools of the Boston Young Men's Christian Association thousands of men who have devoted their time and energies to supplementing their previous education by systematic study in preparation for positions of responsibility.

The phenomenal success of the Association Evening Schools made those in charge of the work feel that there was still more to be done for the men who were unable to get more than a high school education, but who could successfully fill a higher station in life than they held if they could only get the necessary training for it.

The crystallization of this idea resulted in the establishment of our Co-Operative Engineering School, where young men could receive a limited training of technical school grade in those lines which bear directly upon their daily employment. This school was established in the fall of 1909 and marked a new epoch in the educational annals of New England. The plan is to operate a part-time school in co-operation with business firms which employ the students in pairs, each one working alternate weeks, receiving so much per hour for his services while so employed, the earnings from this source being sufficient to defray all expenses of his education.

The school has completed the first year of its existence, and has proved successful from all points of view. The boys have worked hard and faithfully at school, and we have also received most satisfactory reports as to their progress in the shops, and in both places they have evinced the desire to obtain all the knowledge possible. One

very interesting feature has been the practically perfect attendance at the school throughout the year, which alone speaks volumes for the attitude of the pupils toward their work.

A young man taking our four years' course will find that at the end of that time he has obtained a thorough training in the practical side of his employment, as well as a good education in the theoretical points and thus cannot help rising above the plane upon which he would otherwise find himself.

Object of the School

The aim of this school is to fit young men for positions higher than they could reasonably expect to attain without further education than that of a high school course, but who are not financially able to obtain a technical school, or college, training. The work is not in any sense that of a trade school, nor is it exactly that of a high-grade scientific school, but it stands between the two. The work done is that of a regular technical school, but only the essential subjects are taken, and they, only so far as they will have a direct bearing on the life work of the student. In other words it is a limited technical training. The fact that many of the men on our teaching staff are graduates of, or instructors in, the Massachusetts Institute of Technology, is a practical guarantee that the work done will be of scientific school grade and character. To illustrate the idea of the curriculum at the school, take, for instance, the case of a young man who desires to take our Mechanical Engineering Course.

Plan of Work

He is assigned to one of the plants of a manufacturer who is cooperating with us. Here he is put to work and spends that week working at the shop. The next week his mate, who has spent that week in study, takes his place at the shop, and he puts in the week at school. Thus the work goes on, the two men exchanging places at the beginning of each week. The studies pursued in the course have a direct practical bearing on the outside work, with the exception of a few put in, because of the aim we have, to produce a better citizen as well as a better workman. The courses given, have been decided on after conference between the manufacturer and the school authorities and thus will be found to be the result of the best ideas of both. The subjects studied are taught as practical, not as abstract, or theoretical, subjects. Thus, in mathematics, instead of teaching algebra, analytic

geometry, and calculus as so many separate subjects, they are correlated and taught as instruments for the solution of practical problems arising in engineering work. The aim throughout the course is to give it practical bearing and yet to have it complete and thorough in all the needed essentials.

Earnings

Since we want to help those who cannot pay their way through college, they must be able to earn their way as they go, and this is accomplished by our plan. For the work the student does at the factory or shop he is paid a certain amount per hour at the start, and a definite increase per hour after completing fixed periods of service. The sum earned is more than enough to pay the tuition charged and the necessary expenses of schooling, but would not cover the cost of living. Should a student wish to pay his living expenses also, it possibly could be arranged for him to work everyday and spend his evenings taking the courses in the Evening School. The time for completion of the course under these conditions would probably be extended to six years instead of four as is required at the day school. Students desiring to earn all their expenses, both of living and school, may receive the assistance and co-operation of our employment department.

Expenses

The earnings of the students average about two hundred dollars a year while their entire expense for school and membership in the Y. M. C. A. only amounts to one hundred dollars, thus leaving a considerable balance for incidentals.

Correlation of Practical and Theoretical Work

The outside work of the student is as carefully planned as that at the school, and it is progressive. The manufacturers who co-operate with us, agree to put the students to work in all the different departments of their establishments during their periods of practical work; this training is just as complete as the school training, and just as thorough. In general, the course of the learner is from the handling of the raw material to the shipment of the finished product. The practical training will include the use of the machines as well as the executive work of the plant, so that at the end of his course the graduate may not only know how to do things, but also why they are done in certain ways, and he may, we hope, be of value in improving inefficient methods of work. During the past year our boys have been employed by the Boston and Maine Railroad Company; the Boston Consolidated Gas Company, the Boston Elevated Railway Company, and the Boston and Albany Railroad Company. Following are the schedules of practical work that have been prepared for our students by two of the companies:

BOSTON ELEVATED RAILWAY CO.

First Year

Six months, pit work in carhouses. Six months, armature room.

Second Year

Twelve months, machine shop work.

Third Year

Six months, mechanical drafting room. Six months, power station work.

Fourth Year

Six months, line department. Six months, electrical engineer's department.

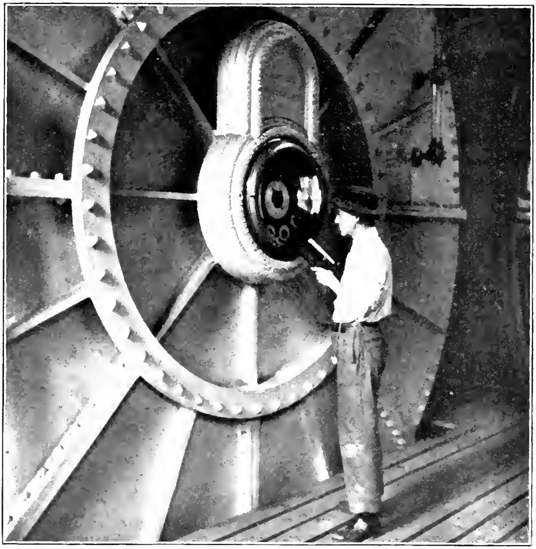
BOSTON CONSOLIDATED GAS CO.

Nine months, data takers.
Three months, office.
Three months, pipe fitters' helpers.
Three months, pump man's helpers.
Three months, blowers and exhausters.
Three months, laboratory.
Three months, valve room.
Three months, generator house.
Three months, steam fitters.
Three months, machine shop.
Three months, assistant engineers.
Three months, engineers.
Six months, laboratory.

The above programmes show what the boys do in their practical work, and the courses of study pursued at the school show what they do along academic lines. It will be seen that there is a considerable degree of correlation between theory and practice in the work they take up. The men, under whose supervision the boys have been in their practical work, are unanimous in approval of our plan, and speak highly of the enthusiasm, earnestness, and intelligence the students have shown in the performance of their duties.

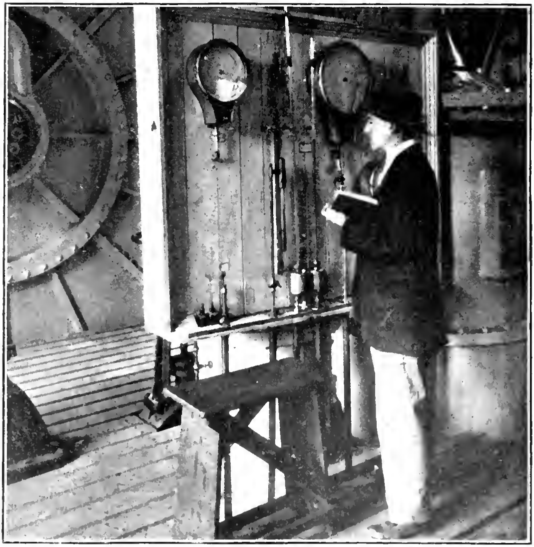
Length of School Year and Vacations

The school year comprises thirty-six weeks of work and thus each student is in attendance for eighteen weeks. All the rest of the year, except one week at Christmas and two weeks during the summer, he is at work for the firm by whom he is engaged.



READING A METER
Everett Works, Boston Con. Gas Co.

TRANSIT WORK
Surveying Class



READING GAUGES
Everett Works, Boston Consolidated Gas Co.

CAR REPAIRING
Grove Hall Station, Boston Elevated Railway Co.

Relation of the School to High Schools

This school is peculiarly adapted to the high school graduate, who although unable to continue his studies further, still has the ambition and ability to get ahead if given the opportunity. Thus boys, being graduated from high school, can still live at home but spend their days in fitting themselves for something better in the future.

Requirements for Admission

Since the success of our undertaking is so directly dependent upon our students, the admission requirements are a little unusual. These requirements are; that a man must be a high school graduate, and must show cause why he may reasonably be expected to make a success of his course, both in the practical work and at the school. He must be willing to work hard, both mentally and physically. All candidates must be accepted by the Dean of the Polytechnic School. In exceptional cases the Dean may, at his discretion, permit candidates who have not a high school diploma to pursue the course. To those unable to enter the Polytechnic School by reason of insufficient preliminary training, we recommend courses in the Preparatory School, a fully equipped and highly organized high school, with day and evening sessions, which prepares students for Harvard College, the Massachusetts Institute of Technology, and other colleges; as well as for Harvard, Boston University, and the Association Institute Law Schools.

Courses to be Given

So far, courses have been arranged in Chemistry, Mechanical and Civil Engineering, but as soon as there is the demand, courses in other subjects will be given. For the present, the student will have to pursue some of his studies with the classes in the Evening School, since the size of the day school does not justify us in having a full corps of instructors putting in all their time. As soon as we are justified in it, the work will be done entirely in the day school.

Tuition

The cost of tuition for the courses in Co-Operative Engineering is one hundred dollars per year, payable as follows: five dollars at the time of registration, twenty-five dollars at the end of September of each year, and the balance at the end of January of each year. This fee of one hundred dollars covers all the expenses of the student at the school as: — books, stationery, laboratory fees, allowing for reasonable breakage, and the use of a set of drafting instruments. All supplies which may be loaned the pupil must be returned in satisfactory condition, otherwise an additional fee will be levied.

Any tools, or other supplies, required at the shops, shall be purchased by the student. This item will probably entail but inconsiderable expense.

All regular students are members of the Boston Y. M. C. A. and entitled to its privileges without additional cost.

Number of Students

Since the number of positions at our disposal in manufacturing concerns is limited, so the number of students we are able to accept is limited; and those desiring to enter the school are advised to notify us at once.

Registration

The shop work begins July 11, 1910, and all candidates should register as soon as possible in order to have due provision made for them. A fee of five dollars must be paid at the time of registration.

Diplomas

At the completion of the course diplomas will be awarded to graduates. These diplomas will be signed by both the school authorities and the manufacturers.

For any further particulars consult the Dean of the Polytechnic School, who will be glad to furnish any desired information.

RESULTS

For the Student

A good technical education.

Practical experience beyond the reach of the average.

Opportunity to earn the expenses of his education.

Training that should enable him to advance rapidly.

Increased earning power.

For the Manufacturer

Men especially and thoroughly trained for his work.

Workmen who can, and will, think.

Men, who, because of theoretical as well as practical education will be progressive and interested in their work.

Following are quotations from letters that have been received from the men in whose charge the boys are during their times of practical work. These give a good idea of their views in regard to the utility of our plan.

PAUL WINSOR, CHIEF ENGINEER

Boston Elevated Railway Company

"I have been interested in following the work of these young men and am pleased to say that the work and behavior of these two have been extremely satisfactory.

"I believe that this Polytechnic course was much needed for young men who are ambitious and willing, but unable to take a full Technology course, and that the results will be satisfactory both to the men and to the companies employing them.

"Judging from the results so far obtained, I believe we could well take ten sets of these men."

JOHN B. RUSSELL, Engineer of Construction

Boston and Albany Railroad

"It gives me pleasure to inform you that my experience during the past six months with the student apprentices from your school has been very satisfactory and this movement meets my hearty approval.

"There are, of course, in the engineering works, certain positions and lines of work in which it is impracticable to employ the students, due to the alternation from week to week, since these positions required the continued attention of one man, but, as a whole, I see no reason why this system cannot be worked out to the mutual advantage of both the student and the employer."

MR. HENRY BARTLETT, General Superintendent Mechanical Department

Boston and Maine Railroad

"The course of instruction which you give them seems to make them well fitted for taking up mechanical work, and I believe it would be a good plan to take on two more boys at an early date."

CAPTAIN WILLIAM McKAY, Engineer of Construction

Boston Consolidated Gas Company

"I am pleased to inform you that the work of the student employees at our Everett Station has proved satisfactory. I think that the general plan of the work promises a successful issue; and our experience thus far has fulfilled our expectations.

"If you can give us two more good boys, we shall be glad to start them in this summer, with the hope that they will continue to demonstrate the practicability of this plan of work."

Mr. J. L. Randall, Inspector of Motive Power Shops

Boston and Maine Railroad

"As I have two apprentices working under me at present, who are going to your school, I have written to our superintendent asking him if it were not possible to have two more boys follow right in line behind them as this is certainly working out very nicely. I am quite anxious to get two more boys if possible to follow in behind these two."

MECHANICAL ENGINEERING

First Year

Mathematics
Mechanical Drawing
Freehand Drawing
English
Physics
Chemistry

Second Year

Mathematics
English
Mechanical Drawing
Physics
Mechanism
Mechanical Engineering Drawing

Third Year

Applied Mechanics
Electrical Engineering
Electrical Engineering Laboratory
Machine Drawing
Steam Engineering
Metallurgy of Iron
Business Law

Fourth Year

Applied Mechanics
Dynamics of Machines
Machine Design
Engineering, Laboratory
Hydraulic Motors
Steam Engineering

Electives

Locomotive Construction

CIVIL ENGINEERING

First Year

Mathematics
Mechanical Drawing
Freehand Drawing
English
Surveying and Plotting
Physics
Chemistry

Second Year

Mathematics
Surveying and Plotting
Physics
English
Mechanical Drawing
Topographical Drawing
Dynamical Geology

Third Year

Railroad Engineering
Advanced Surveying
Structural Geology
Materials
Building Stones and Lithology
Business Law

Fourth Year

Theory of Structures
Bridge Design
Foundations
Railroad Engineering
Railroad Designing
Steam Engineering

CHEMISTRY

First Year

Mathematics
Mechanical Drawing
Freehand Drawing
English
Inorganic Chemistry
Inorganic Chemistry, Laboratory
Physics
German

Second Year

Mechanism
Physics
English
Mathematics
Mechanical Drawing
German
Qualitative Analysis
Quantitative Analysis

Third Year

Quantitative Analysis
Steam Engineering
Machine Drawing
Applied Mechanics
Organic Chemistry
Organic Chemistry, Laboratory
Business Law

Fourth Year

Organic Chemistry
Theoretical Chemistry
Dynamo Electric Machinery
Applied Mechanics
Special Analytical Methods
Oil and Gas Analysis
Electro Chemistry
Electrical Engineering, Laboratory

RULES AND CONDITIONS

Under which Special Apprentices taking the Four Year Co-Operative Engineering Course at the Association Institute, are received for instructions at the Works of

. . . .

1st. The applicant for apprenticeship under this agreement must have satisfactorily passed the requirements for entrance at the Institute.

2nd. The apprentice is to work for us continuously, well and faithfully, under such rules and regulations as may prevail, for the term of approximately 6,800 hours, (or until agreement with the Institute terminates) commencing with the acceptance of this agreement, in such capacity and on such work as specified below:

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. . . .

3rd. The apprentice shall report to his employer for work every alternate week when the Institute is in session, and on all working days when the Institute is not in session, except during vacation periods provided below, and he shall be paid only for actual time at such work.

4th. The apprentice is to have the privilege of a vacation without pay as follows: One week during the Institute Christmas vacation period, and two weeks during the summer vacation, the employer to be notified two weeks in advance.

5th. The employer reserves the right to suspend regular work wholly, or in part, at any time it may be deemed necessary, and agrees to provide other work at the regular rate of pay, for the apprentice during such period.

6th. Should the conduct or work of the apprentice not be satisfactory to employer, or to the Institute, he may be dismissed at any time without previous notice. Dismissal by the employer carries with it dismissal from the co-operative class work at the Institute.

7th. The apprentice must purchase from time to time such tools as may be required for doing rapid and accurate work.

8th. The said term of approximately 6,800 hours (four-year Institute term) shall be divided into four periods as stated below, and the compensation shall be as follows: (payable on regular pay days to each apprentice.)

For the first period of approximately 1700 hours, 10c. per hour.

For the second period of approximately 1700 hours, 12c. per hour.

For the third period of approximately 1700 hours, 14c. per hour.

For the fourth period of approximately 1700 hours, 16c. per hour.

9th. The above wage scale shall begin the eleventh day of July preceding the apprentice's entrance at the Institute.

10th. The apprentice shall have the privilege of profiting by premium, piece work, or any other special system of remuneration in vogue at the time and in the factory where employed.

Association Institute Bulletin
Polytechnic School

1911-12

Co-Operative Engineering Courses

Published By

The Boston Young Men's Christian Association

2, 8 & 10 ASHBURTON PLACE, BOSTON, MASS.

ASSOCIATION INSTITUTE

BULLETIN

OF THE

POLYTECHNIC SCHOOL

1911-12

Co-Operative Engineering Courses

Earning While Learning

BOSTON, MASSACHUSETTS
Published by the Young Men's Christian Association
1911

CALENDAR

1911-1912

July 10	Practical work commences
September 25	School work opens
September 25	Second division of practical work starts
October 12	Columbus Day (No school exercises)
November 30	Thanksgiving Day (No school exercises)
December 23-31	Christmas Recess
February 22	Washington's Birthday (No school exercises)
April 19	Patriots' Day (No school exercises)
May 30	Decoration Day (No school exercises)
June 8	Close of school year

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John E. Rousmaniere, Chairman

William E. Murdock — John Shepard

Albert H. Curtis — D. Chauncey Brewer

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Oliver T. Noon, S.B., Educational Secretary
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Maurice F. Brown, Chief Engineer, Boston Bridge Works

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Henry P. Talbot, Professor of Chemistry, Massachusetts Institute of Technology
Arthur D. Little, Consulting Chemist, A. D. Little Co., Inc.

The following gentlemen have agreed to act in an advisory capacity on the more important executive matters of the school where their service can be of the greatest value to us.

Dr. Richard Maclaurin, President of Massachusetts Institute of Technology
Charles A. Prosser, Deputy Commissioner of Education of Massachusetts
James P. Monroe, Executive Director of "Boston 1915"
William McKay, General Manager, New England Gas & Coke Co.
Paul Winsor, Chief Engineer, Boston Elevated Railway Co.

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H. W. GEROMANOS, Dean

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Charles H. Restall, S.B., Railroad Engineering
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Carl S. Ell, Surveying
Earl Ferry, Applied Mechanics
James A. Cook, Descriptive Geometry and Applied Mechanics
H. W. Geromanos, S.B., Physics and Chemistry
Harold S. Graves, Mechanical and Machine Drawing
Ira A. Flinner, Ph.B., A.M., Mathematics
L. C. Cooper, Mechanism and Machine Design and Mechanical Engineering Drawing
William L. Smith, S.B., Electrical Engineering
A. K. Westervelt, Mechanical and Machine Drawing
Frederick C. Hosmer, English
Thomas E. Penard, S.B., Mathematics
James Brough, Freehand Drawing, Industrial Design and Lettering
George A. Truelson, Architecture
Clarence E. Ebert, Mathematics
Elwood B. Spear, A.B., Ph.D., Chemistry
J. F. Norton, Ph.D., Chemistry
A. L. Chesley, Chemistry

At the time of going to press our annual election of instructors for the coming year has not been held, and so it is impossible to publish the complete list of the faculty for 1911-1912.

GENERAL INFORMATION

It is generally conceded that, where the practical and theoretical forms of education can be taught simultaneously, the greatest good is derived by the student, and an effort is being made in all departments of education to accomplish this greatly desired end.

Technical school instruction, requiring shops, factories and general equipment, is prohibitive because of the tremendous cost. When, however, the actual factory, or shop, and the school can unite their efforts, this required end is accomplished in the most satisfactory manner.

The papers are full of suggestions along this line, and it is with extreme satisfaction that the Association Institute authorities are able to announce that for two years such a school has been in operation by the Young Men's Christian Association, and that it has more than met their most sanguine expectations.

Not only have the school authorities been much gratified with the interest of the students and the progress they have made, but the employers of these young men have been most emphatic in their endorsement of the plan in its bearing upon skilled technical ability.

The following catalog relating to the work will be read with marked interest by all those interested in this modern type of education.

In September, 1909, the Co-Operative Engineering School of the Association Institute was opened, and from the start has proved that it filled a need in our Educational System which was being met by no other school.

When a boy is graduated from a high school he has two roads from which to choose, one leads to a higher institution of learning, the other, which is taken by far the greater number, leads to business pursuits.

But the boy entering business after a high school career, is at once confronted by the fact that, while his education has broadened his view and given him general culture, it has not fitted him for any specific position in any particular line, or occupation. Consequently, he must begin work at the bottom of the ladder, and it may be years before he

mounts even a few of the rounds. After being at work for a time, the ambitious young man sees that if he is going to get ahead at all, he must know more of those subjects which bear directly upon his occupation. To give such young men an opportunity to get a limited, but complete, training of technical school grade in those lines which bear directly upon their daily employment, is the function of our Co-operative School.

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A good technical education

Practical experience beyond the reach of the average.

Opportunity to earn the expenses of his education.

Training that should enable him to advance rapidly.

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Men especially and thoroughly trained for his work.

Employees who can, and will, think.

Men,who, because of theoretical as well as practical education, will be progressive and interested in their work.

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The plan in brief is to operate a part-time school in co-operation with business firms which employ our students in pairs, each one working alternate weeks and receiving so much per hour for his services while so employed, the earnings from this source being sufficient to defray all expenses of his education.

The school has about completed the second year of its existence, and has been successful from all points of view. The students have worked hard and faithfully at school, and we have received most satisfactory reports from their employers as to their progress in the duties of their practical work. In both places, they have evinced the most praiseworthy desire to obtain all the knowledge possible. One

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Plan of Work

" A " is assigned to one of the plants of a manufacturer who is co-operating with us. Here he is to be put to work and spends that week working in the shop. The next week, " B " his mate, who has spent the first week in study, takes " A's " place in the shop, and " A " puts in the week at school. Thus the work goes on, the two men exchanging places at the beginning of each week. The studies pursued in the course have a direct practical bearing on the outside work, with the exception of a few courses added, because of the aim which we have, to produce a better citizen as well as a better employee. The courses given have been decided upon after conference between the manufacturers and the school authorities, and are the result of the best ideas of both. The subjects are taught in a practical, not in an abstract, or a theoretical way. Thus, in mathematics, instead of teaching algebra,

analytic geometry and calculus as so many separate subjects, they are correlated and taught as instruments for the solution of practical problems arising in engineering work. The aim throughout the course is to give it practical bearing and yet to have it complete and thorough in all the essentials.

Correlation of Practical and Theoretical Work

The outside work of the student is as carefully planned as that at the school, and it is progressive. The manufacturers who co-operate with us agree to employ the boys in all the different departments of their establishments during their periods of practical duties; this training is just as complete as the school work and is just as thorough. Where possible, the course of the learner is from the handling of the raw material to the shipment of the finished product. This practical training includes the use of the machines as well as the executive work of the plant, so that at the end of his course the graduate may not only know how to do things, but also why they are done in certain ways, and he may, we hope, be of value in improving methods of work. The following firms are co-operating with us at the present time and giving employment to our students: —

Boston Elevated Railway Co.
Boston and Albany Railroad Co.
    Mechanical Engineering Department
    Civil Engineering Department
Boston & Maine Railroad Co.
    Mechanical Engineering Department
    Civil Engineering Department
Boston Consolidated Gas Co.
Aspinwall and Lincoln, Civil Engineers
New York, New Haven & Hartford Railroad Co.
Boston & Northern Street Railway Co.
    Civil Engineering Department
    Mechanical Engineering Department
Edison Illuminating Co.

A number of other firms have already agreed to co-operate with us, while several more have our plan under consideration.

Below are typical schedules of practical work that have been prepared for our students by some of the companies which are giving our boys employment:

BOSTON ELEVATED RAILWAY CO.

First Year

Six months, pit work in carhouse. Six months, armature room.

Second Year

Twelve months, machine shop work.

Third Year

Six months, mechanical drafting room. Six months, power station work.

Fourth Year

Six months, line department. Six months, electrical engineer's department.

BOSTON CONSOLIDATED GAS CO.

Nine months, data takers
Three months, office
Three months, pipe fitters' helpers
Three months, pump man's helpers
Three months, blowers and exhausters
Three months, laboratory
Three months, valve room
Three months, generator house
Three months, steam fitters
Three months, machine shop
Three months, assistant engineers
Three months, engineers
Six months, laboratory

NEW ENGLAND GAS & COKE COMPANY

Four months, bag wagons
Four months, boilers and engine room
Four months, machine shops
Two months, pipe fitters

Two months, carpenters
Two months, laboratory
Six months, batteries
Two months, condenser house
Two months, coke crusher
Four months, cable roads
Four months, towers
Three months, ammonia house
Three months, shipper's office
Two months, time office
Two months, Laboratory
Two months, general office

BOSTON & MAINE RAILROAD COMPANY

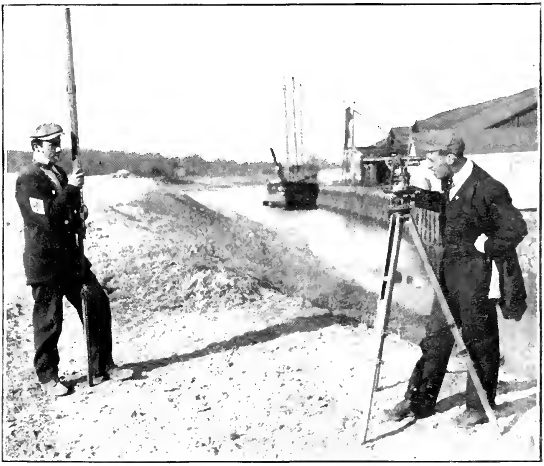
Six months, air brake shops
One year, erecting work
One year, machine shop
One year, engine house repairs
Six months, drafting room and testing work

The above programmes show what the boys do in their practical work, and the courses of study pursued at the school show what they do along academic lines. It will be seen that there is a considerable degree of correlation between theory and practice in the work they take up. The men, under whose supervision the boys have been in their outside work, are practically unanimous in approval of our plan, and speak highly of the enthusiasm, earnestness and intelligence the students have shown in the performance of their duties.

All the concerns which co-operated with us the first year, took one, or more, additional pairs of our students this year, which in itself is significant of their attitude toward our plan.

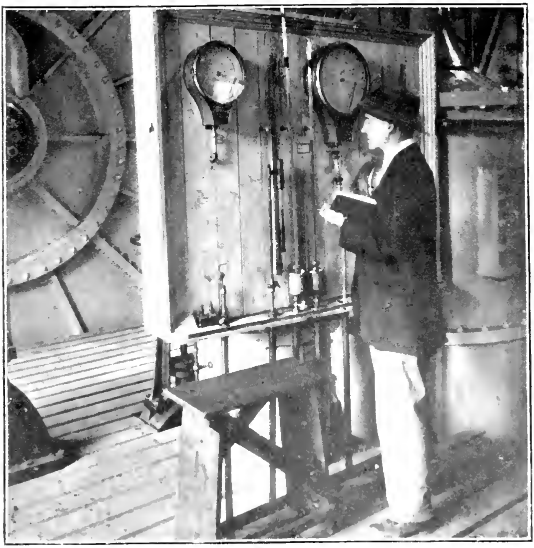
Earnings

For the practical work the student does he is paid a certain amount per hour at the start, and a definite increase per hour after completing fixed periods of service. The sum earned is more than enough to pay

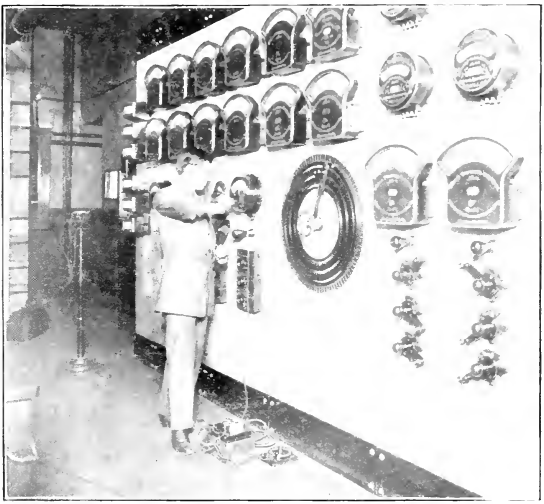


TAKING LEVELS FOR A CROSS SECTION
Weymouth Landing
Aspinwall and Lincoln, Civil Engineers

TAPING A FIELD COIL
Armature Shop
Boston Elevated Railway Company



READING GAUGES
Everett Works
Boston Consolidated Gas Co.



CHECKING VOLTMETERS
Head Place Station
Edison Electric Illuminating Company

the tuition and the necessary expenses of schooling, but will not cover the cost of living. Should a student wish to pay his living expenses also, it possibly could be arranged for him to work every day and spend his evenings taking the course in the Evening School. The time for completion of the course under these conditions would probably be extended to six years instead of four as is required in the day school. Students desiring to earn expenses, both of living and school, may receive the assistance and co-operation of our employment department.

Expenses

The earnings of the students average from $150 to $200 a year while their entire expense for school and membership in the Y. M. C. A. is $100, thus leaving a considerable balance for incidentals.

Relation of the School to High Schools

This school is peculiarly adapted to the high school graduate, who, although unable to continue his studies further, still has the ambition and ability to get ahead if given the opportunity. Thus boys, being graduated from high school, can still live at home but spend their time in fitting themselves for something better in the future.

Courses offered

So far courses have been arranged in Mechanical, Civil, Electrical, and Chemical Engineering. but as soon as there is the demand, courses in other subjects will be given. For the present, the student may have to pursue one of his studies in the Evening School, since the size of the day school does not justify us in having a full corps of instructors putting in their full time. As soon as we are able, the work will be done entirely in the day school.

Physical Training

Provision is made for giving gymnasium instruction to all who desire it. There is no additional expense for this, as the School furnishes the necessary clothing, and all students are strongly urged to avail themselves of this privilege.

Requirements for Admission

In general, the preparation necessary to enable an applicant to pursue successfully one of the regular courses, corresponds with that afforded by high schools of the better grade, offering a four year course of study.

Every applicant must furnish references as to his character and ability, and must show cause why he may reasonably be expected to make a success of his course, both in the practical work and at the school. He must be willing and able to work hard, both mentally and physically.

For those unable to carry on the Engineering work owing to inadequate preliminary training, it has been found possible to plan special courses, of one or two years' duration in the Preparatory School to fit for the Engineering Courses.

There are no examination requirements for entrance this year, but on, and after July, 1912, all candidates for admission will be required to pass examinations in Elementary Algebra, Plane Geometry, Elementary Physics, English Composition and Mechanical Drawing.

The examinations for entrance will be held at the Association Building on June 13 and 14, 1912, and on September 12 and 13, 1912.

The detailed requirements in the various subjects are as follows:

Algebra. The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one, or more, unknown quantities: problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative.

Plane Geometry. The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

English. The examination in English will be as far as possible a test of the candidate's ability to express himself in writing in a manner at once clear and accurate.

The candidate will be required to write upon subjects familiar to him. His composition should be correct in spelling, punctuation, grammar, idiom and formation of paragraphs, and should be plain and natural in style. He will be judged by how well, rather than by how much, he writes.

Physics. The candidate will be expected to be familiar with the fundamental principles of Physics. It is especially desirable that he should have a good knowledge of general mechanics and of the mechanics of solids, liquids and gases. A knowledge of physical hypotheses is comparatively unimportant. Textbook instruction should be supplemented by lecture-room experiments. A sufficiently extended treatment of the subject will be found in any of the principal textbooks now in use in secondary schools. Ability to solve simple problems will be expected.

Mechanical Drawing. The applicant must be familiar with the projections of points, lines, planes and simple solids. Special attention is called to the importance of neatness and accuracy, and to facility in lettering and dimensioning drawings. Plates should be presented, showing the ground covered by the applicant.

Registration

Before becoming a member of the school the student is required to fill out, and hand in at the office, an attendance card, blank forms of which will be supplied. A ten dollar registration fee, which is non-returnable, is to be paid at the same time. This fee is credited to the student as part payment toward his tuition.

The practical work begins July 10, 1911, and candidates desiring to start at that time should register as soon as possible, that due provision may be made for them.

Those who do not wish to start until September should register at once stating their preference, that they may be taken care of at the proper time. The practical work starts September 25th.

Attendance

Students are expected to attend all the exercises of their several courses. In case of necessary absence the Dean will grant an excuse. Unnecessary absence from recitations will be dealt with severely.

Status of Students

The ability of students to continue their courses is determined in part by means of examinations; but regularity of attendance and faithfulness to daily duties are considered equally essential.

Number of Students

Since the number of positions at our disposal is limited, and as several students have already registered to start in this coming year, those desiring to enter the school are advised to apply for admission at the earliest possible date. The early applicants have a choice of the positions open.

Examinations

General examinations in all subjects will be held at the close of each school year and will cover the work of the entire year. They will be divided into two sections, one confined to the work of the first half year, the other to the work of the second half year. All students who have maintained a yearly average of 80 per cent or over in any study may be excused from the examination in that study at the discretion of the instructor in charge, and with the approval of the Dean. All other students will take the examinations and their standing for the year will be based half on the rank obtained in the year's work and half on the rating obtained on the examination.

Intermediate examinations the results of which are not a matter of permanent record, but are primarily for the information of students and their parents or guardians, may be held at any time.

Reports of Standing

Intermediate reports are sent out during the school year and at the close of the year final reports with the standings obtained in the year's work, are sent to the parents of the student.

Fees

The tuition fee is $100 per year and must be paid as follows:

Ten dollars at the time of registration.

Ten dollars additional before receiving any supplies.

Thirty dollars December 1.

Thirty dollars February 1.

Twenty dollars April 1.

This fee includes full membership in the Association with gymnasium privileges, as well as the use of all books, drawing supplies, etc., etc., which are required in the school work. Such supplies as are required by the student for his school work are loaned to him by the school and must be returned on demand in good condition, or else paid for.

Diplomas

At the completion of the course diplomas will be awarded to graduates. These diplomas will be signed by both the school authorities and the employers.

School Year and Vacations

The school opens on the last Monday in September. There are no recesses save that at Christmas, except on legal holidays, and the school year closes on the first Saturday in June.

The school year comprises thirty-six weeks of work and thus each student is in attendance for eighteen weeks. All the rest of the year except one week at Christmas and two weeks during the summer he is at work for the firm by whom he is engaged.

Following are quotations from letters that have been received from the men in whose charge the boys are during their times of practical work. These give a good idea of their views in regard to the utility of our plan.

Paul Winsor, Chief Engineer
Boston Elevated Railway Company

" I have been interested in following the work of these young men and am pleased to say that the work and behavior of these two have been extremely satisfactory.

"I believe that this Polytechnic course was much needed for young men who are ambitious and willing, but unable to take a full Technology course, and that the results will be satisfactory both to the men and to the companies employing them.

"Judging from the results so far obtained, I believe we could well take ten sets of these men."

JOHN B. RUSSELL, Engineer of Construction
Boston and Albany Railroad

"It gives me pleasure to inform you that my experience during the past six months with the student apprentices from your school has been very satisfactory and this movement meets my hearty approval.

"There are, of course, in the engineering works, certain positions and lines of work in which it is impracticable to employ the students, due to the alternation from week to week, since these positions required the continued attention of one man, but, as a whole, I see no reason why this system cannot be worked out to the mutual advantage of both the student and the employer."

MR. HENRY BARTLETT, General Superintendent Mechanical Department
Boston and Maine Railroad

"The course of instruction which you give them seems to make them well fitted for taking up mechanical work, and I believe it would be a good plan to take on two more boys at an early date."

MR. J. L. RANDALL, Inspector of Motive Power Shops
Boston and Maine Railroad

"As I have two apprentices working under me at present, who are going to your school, I have written to our superintendent asking him if it were not possible to have two more boys follow right in line behind them as this is certainly working out very nicely. I am quite anxious to get two more boys if possible to follow in behind these two."

COURSES OF STUDY

MECHANICAL ENGINEERING

First Year
Mathematics
Business English
Chemistry
Physics
Mechanical Drawing
Descriptive Geometry
Elementary Applied Mechanics
Lettering

Second Year
Descriptive Geometry
Mathematics
Business English
Mechanical Engineering Drawing
Mechanism and Machine Design
Applied Mechanics
Physics
Valve Gears
Surveying
Chemistry

Third Year
Applied Mechanics
Mathematics
Machine Drawing
Thermodynamics
Electrical Engineering
Electrical Engineering Laboratory
Mechanical Engineering Drawing
Surveying

Fourth Year
Metallurgy of Iron
Applied Mechanics
Dynamics of Machines
Electrical Engineering
Electrical Engineering Laboratory
Machine Design
Foundations
Hydraulic Motors
- Elective
  - Locomotive Engineering
  - Power Plant Design

CHEMICAL ENGINEERING

First Year
Mathematics
Business English
Chemistry
Chemical Laboratory
Physics
Mechanical Drawing
Descriptive Geometry
Elementary Applied Mechanics
Lettering
German

Second Year
Qualitative Analysis
Mechanism
Mathematics
Business English
Physics
Descriptive Geometry
German
Valve Gears
Mechanical Engineering Drawing
Applied Mechanics

Third Year
Quantitative Analysis
Thermodynamics
Mechanical Engineering Drawing
Machine Drawing
Applied Mechanics
Organic Chemistry
Heat Engineering
Technical Analysis
Surveying

Fourth Year
Organic Chemistry
Organic Chemical Laboratory
Industrial Chemistry
Dynamo Electric Machinery
Theoretical Chemistry
Applied Mechanics
Electrical Engineering Laboratory

CIVIL ENGINEERING

FIRST YEAR

Mathematics
Business English
Chemistry
Physics
Mechanical Drawing
Descriptive Geometry
Elementary Applied Mechanics
Lettering
Surveying

SECOND YEAR

Mathematics
Business English
Surveying and Plotting
Physics
Chemistry
Mechanism
Descriptive Geometry
Topographical Drawing
Applied Mechanics
Stereotomy

THIRD YEAR

Railroad Engineering
Advanced Surveying
Dynamical Geology
Dynamo Electric Machinery
Theory of Structures
Materials
Testing Materials

FOURTH YEAR

Metallurgy of Iron
Theory of Structures
Bridge Design
Foundations
Heat Engineering
Advanced Structures
  Elective
    Railroad Engineering
    Railroad Design

ELECTRICAL ENGINEERING

FIRST YEAR

Mathematics
Business English
Chemistry
Physics
Mechanical Drawing
Descriptive Geometry
Elementary Applied Mechanics
Lettering

SECOND YEAR

Mathematics
Business English
Mechanism and Machine Design
Valve Gears
Mechanical Engineering Drawing
Descriptive Geometry
Surveying
Applied Mechanics

THIRD YEAR

Electrical Engineering
Electrical Laboratory
Thermodynamics
Applied Mechanics
Alternating Currents
Technical Electrical Measurements
Machine Drawing

FOURTH YEAR

Alternating Current Machinery
Electrical Engineering Laboratory
Electrical Light and Transmission of Power
Technical Electrical Measurements
Hydraulic Engineering
Stationary Structures

CATALOG

OF THE

Co-Operative Engineering SCHOOL

1912-1913

PUBLISHED BY THE

EDUCATIONAL DEPARTMENT

OF THE

BOSTON YOUNG MEN'S CHRISTIAN ASSOCIATION

HUNTINGTON AVENUE, BOSTON, MASS.

(2, 8 and 10 Ashburton Place until October 1, 1912)

CATALOG

OF THE

Co-Operative Engineering School

CATALOG

OF THE

INSTRUCTING STAFF

TOGETHER WITH

A Statement of the Requirements for Admission

AND

A Description of the Courses of Instruction

1912-1913

OUR NEW HOME

The above cut represents the new Association Building now under process of construction on Huntington Ave. It will contain among other features, school accommodations of the very best, a fine gymnasium, bowling alleys, swimming pool, cafe, dormitories, shops and laboratories, camera club rooms, social and recreative rooms and auditorium.

The educational portion of the building will be ready for occupancy October 1, 1912

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Officers of Administration

General Administrative Officers

ARTHUR S. JOHNSON, *President*
JACOB P. BATES, *Vice-President*
HAROLD PEABODY, *Recording Secretary*
FRANCIS B. SEARS, *Treasurer*

GEORGE W. MEHAFFEY, *General Secretary*

Educational Committee

JOHN ROUSMANIERE, *Chairman*
WILLIAM E. MURDOCK
ALBERT H. CURTIS
MORGAN L. COOLEY
GEORGE P. HITCHCOCK

Educational Administrative Officers

FRANK P. SPEARE, *Educational Director*
GALEN D. LIGHT, *Asst. Educ. Director and Bursar*
H. W. GEROMANOS, *Supt. of Evening School System*
IRA A. FLINNER, *Supt. of Day School System*
CHARLES B. GRAY, *Secretary*

Advisers

The following gentlemen have agreed to act in an advisory capacity on the more important executive matters of the school where their service can be of the greatest value to us.

Dr. Richard Maclaurin, President of Massachusetts Institute of Technology

Charles A. Prosser, Secretary of National Commission on Industrial Education

James P. Munroe, Secretary of Massachusetts Institute of Technology Corporation

William McKay, General Manager, New England Gas & Coke Co.

Paul Winsor, Chief Engineer, Boston Elevated Railway Company

Officers of Instruction

H. W. GEROMANOS, S.B., Mass. Inst. Tech., Dean

Royal D. Bradbury, S.B., Concrete Construction

James Brough, Industrial Design and Lettering

A. L. Chesley, Chemistry

J. A. Coolidge, S.B., Mathematics and Physics

Carl S. Ell, S.B., M.S., Surveying and Applied Mechanics

A. L. Gardiner, S.B., Valve Gears

H. W. Geromanos, S.B., Descriptive Geometry and Chemistry

Harold Graves, Mechanical Drawing and Lettering

Frederick C. Hosmer, A.B., English

John W. Howard, S.B., Surveying

John Indlekoffer, Mathematics

Ervin Kenison, S.B., Descriptive Geometry

J. F. Norton, S.B., Ph.D., Chemistry

Thomas E. Penard, S.B., Mathematics

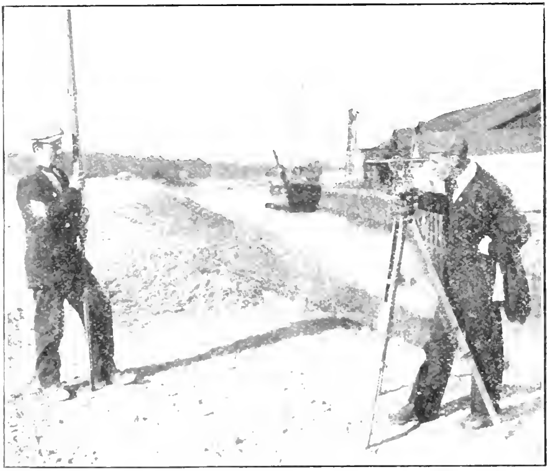
Charles H. Restall, S.B., Railroad Engineering

W. Lincoln Smith, S.B., Electrical Engineering

Ellwood B. Spear, A.B., Ph.D., Chemistry

R. F. Symonds, S.B., Mechanism and Mechanical Engineering Drawing

At the time of going to press, our annual election of instructors for the year has not been held, and so it is impossible to publish a complete list of the faculty for 1912-1913.



TAKING LEVELS FOR A CROSS SECTION
Weymouth Landing
Aspinwall and Lincoln, Civil Engineers

TAPING A FIELD COIL
Armature Shop
Boston Elevated Railway Company

Calendar

1912

February 22, Thursday
Washington's Birthday (School exercises omitted)

April 19, Friday
Patriots' Day (School exercises omitted)

May 20—June 1
Final Examinations

June 1
Close of School year

June 2 to September 29, inclusive
Summer vacation

June 13 and 14, Thursday and Friday
Entrance examinations of Co-Operative Engineering School

July 8—12
Practical work commences for First Division

September 12 and 13, Thursday and Friday
Second Entrance examinations

September 23—30
Practical work commences for Second Division

September 30, Monday
School work of year 1912-1913 begins

October 12, Saturday
Columbus Day (School exercises omitted)

November 28, Thursday
Thanksgiving Day (School exercises omitted)

December 23 to December 27, inclusive
Christmas Recess

1913

February 22, Saturday
Washington's Birthday (School exercises omitted)

April 19, Saturday
Patriots' Day (School exercises omitted)

June 2—14
Final Examinations

June 14
Close of School year

June 15 to September 14, inclusive
Summer vacation

June 19—21, Thursday to Saturday
Entrance Examinations of Co-Operative Engineering School

July 7—12
Practical work commences for First Division

September 11—13, Thursday to Saturday, inclusive
Second entrance examinations

September 15
School work of year 1913-1914 begins

September 15—20
Practical work commences for Second Division

General Information

It has generally been conceded that where the practical and the theoretical elements of education can be taught simultaneously, the greatest good is derived by the student, and efforts are being made in all departments of education to accomplish this greatly desired end.

Technical school instruction, depending on class room work and laboratories, must always lack some of the vital characteristics of an actual manufacturing plant, owing to the fact that one is for educational purposes, while the other is operated for dividends. It is this latter fact that gives the Co-Operative School idea one great advantage over our usual educational plan. Instead of protecting the student, and training him for several years for a line of work to which he may later find himself to be entirely unfitted, the boy in the Co-Operative School is at once put to work in a commercial plant, and there learns life in its vital issues, as well as the problem of getting along with men; thus early finding out whether he has made a wise, or unwise, choice of his life work. This training, too, shows him the use and value of his school work, and finally gives him an unusual opportunity to acquire from actual experience that rare thing, *executive ability*, without which his life probably will always be spent on the lower levels of industry.

That the young men of New England might have an opportunity to attend such a technical school, where both practice and theory are correlated, and at the same time be enabled to defray a large part of the expense of their education by the returns from their practical work, the Co-Operative Engineering School of the Boston Young Men's Christian Association was started in 1909.

This school has now been in operation for three years, and the continually increasing interest in it, as well as its rapid and steady growth, show that it was much needed to fill a place that is filled by no other school in this vicinity.

OBJECT OF THE SCHOOL

The fundamental aim of this school is to fit young men for positions along Engineering lines, higher than they could reasonably expect to attain without further education than that of a high school course, but who are not able to attend the highest grade technical schools, or colleges. The training is not in any sense that of a trade school, nor is it exactly that of our best scientific schools, but it stands between the two. The work done is that of a regular technical school, of high standards, but only the essential subjects are taken, and they, only so far as they will have a direct bearing on the life work of the student. In other words, it is a limited technical training of high grade. The fact that most of our instructors are graduates of, or instructors in, the Massachusetts Institute of Technology, will show the character of work being done.

At present there are four lines of Engineering work being given, and the end sought is to give to students who have already had a high school preparation, or its equivalent, a good training in the fundamental sciences of Mathematics, Chemistry, and Physics, and in the important applications of the principles of these sciences to the several branches of engineering. Much more stress is laid on the development of the ability to apply effectively the knowledge acquired to new engineering problems, than to the memorizing of a multitude of details and to very abstract theory, which, while valuable, cannot be gone into too deeply in a course of this type.

The class room instruction is given to small sections, and in the drawing rooms and laboratories, the students receive a great deal of personal attention. The independent solution of assigned problems forms a large part of nearly all courses.

The Courses differ from those of many schools, in that a student is not permitted a wide range of subjects from which to choose, in the belief that better results are obtained by prescribing, after the student has selected the line of work for which he desires to prepare himself, the principal studies which he is to pursue.

PLAN OF OPERATION OF THE SCHOOL

To illustrate the idea of the curriculum at the school, take for instance, the case of a young man "A" who desires to take our Mechanical Engineering course.

"A" is assigned to one of the plants of a firm that is co-operating with us. Here he is put to work and spends that week working in the shop. The next week, "B" his mate, who has spent the first week in the school, takes "A's" place in the shop, and "A" puts in the week at school. Thus the work goes on, the two men exchanging places at the beginning of each week. The studies pursued in the course have a direct practical bearing on the outside work, with the exception of a few courses added, because of the aim which we have, to produce a better citizen, as well as a better employee. The courses given have been decided upon after conference between the co-operating employers and the school authorities, and are the result of the best ideas of both. The subjects are taught in a practical, not in an abstract, or a theoretical way. Thus, in mathematics, instead of teaching algebra, analytic geometry and calculus as so many separate subjects, they are correlated and taught as instruments for the solution of practical problems arising in engineering work. The aim throughout the course is to give it practical bearing and yet have it complete and thorough in all the needed essentials.

Correlation of Practical and Theoretical Work

The outside work of the student is as carefully planned as that at the school, and it is progressive. The manufacturers who co-operate with us generally agree, where practicable, to employ the boys in all the different departments of their establishments during their periods of practical duties; this training is just as complete as the school work, and is just as thorough. Where possible, the course of the learner is from the handling of the raw material to the shipment of the finished product. This practical training includes the use of the machines, as well as the executive duties of the plant, so that at the end of his course the graduate may not only know how to do things, but also why they are done in certain ways, and he may, we hope, be of value in improving methods of work. The following

firms are co-operating with us at the present time and giving employment to our students:—

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  Mechanical Engineering Department
  Civil Engineering Department
Boston Consolidated Gas Co.
Aspinwall and Lincoln, Civil Engineers
New York, New Haven & Hartford Railroad Co.
Bay State Street Railway Co.
  Civil Engineering Department
  Mechanical Engineering Department
Edison Electric Illuminating Co.
New England Gas and Coke Co.
Simplex Electrical Company

A number of other firms have already agreed to co-operate with us, while several more have our plan under consideration and we have every reason to believe most of them will co-operate with us in the near future.

Below are typical schedules of practical work that have been prepared for our students by some of the companies which are giving our boys employment:—

BOSTON ELEVATED RAILWAY CO.

First Year

Six months, pit work in carhouse.
Six months, armature room.

Second Year

Twelve months, machine shop work.

Third Year

Six months, mechanical drafting room.
Six months, power station work.

Fourth Year

Six months, line department.
Six months, electrical engineer's department.

BOSTON & MAINE RAILROAD COMPANY

Six months, air brake shops.
One year, erecting work.
One year, machine shop.
One year, engine house repairs.
Six months, drafting room and testing work.

BOSTON CONSOLIDATED GAS CO.

Nine months, data takers.
Three months, office.
Three months, pipe fitter's helpers.
Three months, pump man's helpers.
Three months, blowers and exhausters.
Three months, laboratory.
Three months, valve room.
Three months, generator house.
Three months, steam fitters.
Three months, machine shop.
Three months, assistant engineers.
Three months, engineers.
Six months, laboratory.

NEW ENGLAND GAS & COKE COMPANY

Four months, bag wagons.
Four months, boilers and engine room.
Four months, machine shops.
Two months, pipe fitters,
Two months, carpenters.
Two months, laboratory.
Six months, batteries.
Two months, condenser house.
Two months, coke crusher.
Four months, cable roads.
Four months, towers.
Three months, ammonia house.
Three months, shipper's office.
Two months, time office.
Two months, laboratory.
Two months, general office.

SIMPLEX ELECTRICAL COMPANY

Six months, Insulating Department.
Six months, Braiding Department.
Six months, Cable Shop.
Six months, Twisting Department.
Six months, Machine Shop Construction Gang.
Six months, Electrical Construction Gang.
One year, Testing Room.

The above programmes show what the boys do in their practical work, and the courses of study pursued at the school show what they do along academic lines. It will be seen that

there is a considerable degree of correlation between theory and practice in the work they take up. The men under whose supervision the boys have been in their outside work, are practically unanimous in approval of our plan, and speak highly of the enthusiasm, earnestness and intelligence the students have shown in the performance of their duties.

Attitude of Co-operating Firms

Almost all the concerns which co-operated with us the last year, took one, or more, additional pairs of our students this year, which in itself is significant of their attitude toward our plan.

Earnings

For the practical work the student does, he is paid a certain amount per hour at the start, and a definite increase per hour after completing fixed periods of service. The sum earned is more than enough to pay the tuition and the necessary expenses of schooling, but will not cover the cost of living.

In some cases the boys are paid at a higher rate than is called for by their schedule of pay, but that is a courtesy of the company that gives them employment and is not in any way to be expected as a regular thing. The co-operating firms may make any salary schedule they desire, so long as it does not fall below that originally agreed upon.

The companies which co-operate with us, agree to pay our students ten (10) cents per hour during their first year of service; twelve (12) cents per hour during the second year; fourteen (14) cents per hour during the third year, and sixteen (16) cents per hour during the fourth year.

Basing the earnings on this scale, the student will earn from five (5) to six (6) dollars per working week during the first year, and an increase of approximately one (1) dollar per working week, for each succeeding year of the four. As there are about thirty weeks of work per year, the earnings will be from one hundred and fifty dollars, upwards.

Expenses

As the earnings of the students average from $150 to $200 a year, while their entire expense for school and membership in

the Y. M. C. A. is $100, there is a considerable balance for incidentals.

Relation of the Co-Operative School to High Schools

This school is peculiarly adapted to the high school graduate who, although financially unable to continue his studies further, still has the ambition and ability to get ahead if given the opportunity. Thus boys, being graduated from high school, can still live at home but spend their time in fitting themselves for something better in the future.

Number of Students

The number of positions at our disposal is necessarily limited and so the number of students who can work part-time is also limited. In consequence of this, those students who apply first, will get first consideration in the matter of positions, and those who wish to enter should get in their applications as soon as possible.

Already a large number have applied for entrance in 1912 and most of the places we have, will be filled by these men, provided they are accepted by the co-operating firms and succeed in passing the entrance examinations.

Those applicants who apply for admission to the School too late to be assigned to practical work, may attend the School every week, or every alternate week, as they may wish, and will be assigned to practical work as soon as an opening occurs.

Outside Interests

A moderate participation in social and athletic activities is encouraged by the Faculty, although a standard of scholarship is required of the students which is incompatible with excessive devotion to such pursuits.

Four-year Courses

Regular four-year courses leading to a diploma, are offered in the following branches of engineering:—

Civil Engineering.
Mechanical Engineering.
Chemical Engineering.
Electrical Engineering.

Descriptions of these courses and schedules showing the subjects of instruction included will be found on succeeding pages.

Summer Schools

There is an evening summer preparatory school conducted by the Educational Department of the Association, and students having entrance conditions, or requiring further preparation for the entrance examinations, may avail themselves of this opportunity to cover the desired work.

Those of our students who fail to pass in any of their school work may be permitted to take up the study in the Summer School conducted by the Institute of Technology, provided of course, that Institution is offering such a course. Those students desiring this privilege should consult the Dean as special permission must be obtained to attend many of the courses.

Physical Training

Provision is made for giving gymnasium instruction to all students who desire it. The classes meet twice a week during the school year, but students who desire more exercise are permitted the use of the gymnasium at other times and are also allowed to go in with other classes.

Requirements for Admission

Detailed information in regard to the requirements for admission to the courses of instruction in the School will be found on succeeding pages. In general, the preparation necessary to enable an applicant to pursue one of the Courses corresponds with that given by good high schools in their four years' course.

School Year

The term begins September 30th, 1912, but on succeeding years the school year will commence on the third Monday in September. The date of opening has been placed late for the Fall of 1912, owing to the necessity of awaiting the completion of our new building. The school exercises are suspended on legal holidays and for one week at Christmas.

Registration

Each applicant for admission to the School is required to fill out a blank whereon he states his places of previous education as well as the names of persons to whom reference may be made in regard to his character and training. A deposit of (1) dollar is required when this application blank is filed. Should the applicant be rejected, one-half of this fee, or fifty cents, will be returned to him: should the application be approved, the fee will be applied toward his tuition.

When the application has been approved, the student is required to fill out an attendance card, blank forms of which will be supplied. A ten-dollar registration fee, which is non-returnable, is to be paid at the same time. This fee is also credited to the student as part payment toward his tuition.

Before a student will be put to work, or allowed to attend classes, this initial fee of ten (10) dollars must be paid.

An additional ten (10) dollars is required to be paid before any books, or supplies, are issued to him.

Attendance

Students are expected to attend all exercises in the subjects they are studying, unless excused by the Dean. With the exception of one hour in the middle of the day, exercises are held, and students are, in general, expected to devote themselves to the work of the school between 9 A.M. and 5 P.M. There are no exercises on Saturday after 12 N.

Status of Students

The ability of students to continue their courses is determined in part by means of examinations; but regularity of attendance and faithfulness to daily duties are considered equally essential.

Any student failing to make a satisfactory record in either school, or practical work, may be removed from his position in practical work.

Examinations

Examinations in all subjects are held at the close of each school year, in May and June, and cover the work done during

the year. All students who maintain a year's average of 80% or over, in their daily work and informal examinations, in any subject, may be excused from the final examination in that subject, at the discretion of the instructor in charge and with the approval of the Dean. When a final examination is taken, the year's rating in the subject is based half on the examination and half on the record of the year's work.

Students will not be admitted to professional work in the several courses without satisfactory records in those previous subjects on which the former especially depend. That is, for illustration, a student cannot take Advanced Surveying until he has completed Elementary Surveying.

Exceptions to this rule may be made in individual cases after special consideration by the instructor in charge and the Dean.

Reports

Informal reports in all subjects are sent every two months, and formal reports covering the year's work are sent at the close of each year. These reports are sent to students, and to the parents, or guardians, of the students. Notification will be made to parents, or guardians, in all cases of students advised, or required, to withdraw, or placed on probation.

Special Students

It is possible for students to enter the School and spend either every week at school, or else every other week at school, without being placed in practical employment. There is no extra charge under these conditions.

Socials

In order to provide for the social intercourse of the students, as well as to enable the men in the different divisions to meet one another, socials and entertainments are held monthly for their exclusive enjoyment. An out door field meet is also held yearly, in May, at which time various inter-class competitive games are held.

Vacations

The employers allow our students one week vacation at Christmas, and two weeks vacation during the summer. They are not paid for this time.

Summer Employment

When a student, for good reason, is unable to continue his practical work during the summer, when the school is not in session, it is frequently possible to get him leave of absence for the summer so that he can return to his employer in the fall. All special arrangements for the summer work must be referred to the Dean.

Conduct

It is assumed that students come to the School for a serious purpose, and that they will cheerfully conform to such regulations as may from time to time be made. In case of injury to any building, or to any of the furniture, apparatus, or other property of the school, the damage will be charged to the student, or students, known to be immediately concerned; but, if the persons who caused the damage are unknown, the cost of repairing the same may be assessed equally upon all the students of the School.

Students are expected to behave with decorum, to obey the regulations of the School, and to pay due respect to its officers. Conduct inconsistent with the general good order of the School, or persistent neglect of work, if repeated after admonition, may be followed by dismissal, or, in case the offense be a less serious one, the student may be placed upon probation. The student so placed upon probation may be dismissed if guilty of any further offense.

It is the aim so to administer the discipline of the School as to maintain a high standard of integrity and a scrupulous regard for truth. The attempt of any student to present, as his own, any work which he has not performed, or to pass any examination by improper means, is regarded as a most serious offense, and renders the offender liable to immediate expulsion. The aiding and abetting of a student in any dishonesty is also held to be a grave breach of discipline.

REQUIREMENTS FOR GRADUATION

To be graduated by the School, the student must have satisfactorily completed all subjects of his chosen course and in addition to this, he must have completed his period of practical work to the satisfaction of his employer.

No student will be graduated until all dues to the school

are discharged. The diplomas awarded graduates will be signed by both the school authorities and the employers.

Fees

The tuition fee is $100 per year and must be paid as follows:

Ten dollars at the time of registration.
Ten dollars additional, before receiving any supplies.
Thirty dollars December 1.
Thirty dollars February 1.
Twenty dollars April 1.

This fee includes full membership in the Association with gymnasium privileges, as well as the use of all books, drawing supplies, etc., etc., which are required in the school work. Such supplies as are required by the student for his school work are loaned to him by the School and must be returned on demand, in good condition, or else paid for.

Deposits

All deposits made when filing application cards, or before examinations, will be credited as part of this $100.

Increase of Tuition

The tuition of all students entering the school, on, and after, September first, 1913, will be $110 per year. Those students who are already members of the school at that time will be allowed to complete their course at the same rate of tuition that existed at the time of their entrance.

Payments

All payments should be made to Galen D. Light, Bursar.

Residence

For those students who will not be living at home, there will be excellent accommodations at very moderate rates in the dormitories that are being constructed in our new building. These rooms may be had separately, or in groups with a common reception room, and the price will vary from $1.50, or $2.00 upwards. As board costs from $3.50 to $5.00 a week, a student

could get room and board for from $5.00 a week to $6.00 per week.

Location

The buildings are located on Huntington Avenue, just beyond Massachusetts Avenue, and are within easy access to the various railroad stations, and the business and residential sections by electric cars.

REQUIREMENTS FOR ADMISSION

In general, the preparation necessary to enable an applicant to pursue successfully one of the regular courses, corresponds with that afforded by high schools of the better grade, offering a four year course of study.

Every applicant must furnish references as to his character and ability, and must show cause why he may reasonably be expected to make a success of his course, both in the practical work and at the School. He must be willing and able to work hard, both mentally and physically.

For those unable to carry on the Engineering Work owing to inadequate preliminary training, it has been found possible to plan special courses, of one, or two years' duration in the Preparatory School to fit for the Engineering Courses.

All applicants planning to take the examinations shall notify the Dean not less than ten days previous to the date of the examinations. For those students who may not be prepared to take the examinations in June, but who desire to work during the summer and then take the examinations in the Fall, arrangements may be made by consultation with the Dean.

Any subjects not passed in the June examinations may be passed at the September examinations.

Applicants for admission to the Co-Operative Engineering School are, in general, required to pass the entrance examinations of the School. Certificates of entrance examinations passed for admission to another similar school of the same, or higher grade, may be accepted in lieu of examinations.

ADMISSION TO THE FIRST YEAR

The student intending to enter the School should bear in mind that the broader his intellectual training in any direction, and the more extensive his general acquirements, the greater will be the advantages he may expect to gain. The importance of thorough preparation in the subjects set for examination also is great; for the character and the amount of instruction given in the School from the outset, leave little opportunity for one imperfectly fitted to make up deficiencies, and render it impossible for him to derive the full benefit from his course, or perhaps even to maintain his standing. The training given in the best high schools and manual training high schools, will, in general, afford suitable preparation.

The requirements of age and scholarship specified are regarded as a minimum in all ordinary cases, and only exceptional circumstances will justify any relaxation. Parents and guardians are advised that it is generally for the ultimate advantage of the student not to enter under the age of eighteen years.

ENTRANCE EXAMINATIONS IN BOSTON

Examinations for admission to the first year class will be held at 10 Ashburton Place on June 13th and 14th and on September 12th and 13th, 1912.

Students are advised to attend the June Examinations if possible, in order that any deficiencies then existing may be made up in September before entrance.

Fees

Before taking the examination the applicant must deposit the sum of five (5) dollars with the Bursar. If he passes the examination the fee will be credited toward his tuition, if he fails to pass, one-half the fee will be returned, the balance being retained to defray the expenses of making out the examination and correcting the papers.

Order of Examinations

Friday, June 14, 1912

8.45 A.M. to 9.00 A.M. Registration of Applicants

9.00 A.M. to 10.30 A.M.	Physics
10.30 A.M. to 12.00 N.	English
2.00 P.M. to 4.00 P.M.	Algebra

Saturday, June 15, 1912

9.00 A.M. to 10.30 A.M.	Plane Geometry
10.30 A.M. to 12.30 P.M.	Mechanical Drawing

Plane Geometry

The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

Algebra

The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one, or more, unknown quantities; problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative.

English

The examination in English will be as far as possible a test of the candidate's ability to express himself in writing in a manner at once clear and accurate.

The candidate will be required to write upon subjects familiar to him. His composition should be correct in spelling, punctuation, grammar, idiom and formation of paragraphs, and should be plain and natural in style. He will be judged by how well, rather than by how much, he writes.

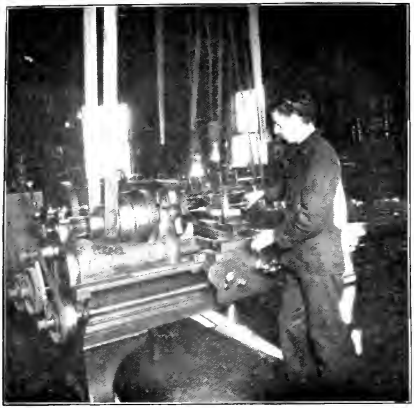
Physics

The candidate will be expected to be familiar with the fundamental principles of Physics. It is especially desirable that he should have a good knowledge of general mechanics and of the mechanics of solids, liquids and gases. A knowledge

of physical hypotheses is comparatively unimportant. Textbook instruction should be supplemented by lecture-room experiments. A sufficiently extended treatment of the subject will be found in any of the principal textbooks now in use in secondary schools. Ability to solve simple problems will be expected.

Mechanical Drawing

The applicant must be familiar with the projections of points, lines, planes and simple solids. Special attention is called to the importance of neatness and accuracy, and to facility in lettering and dimensioning drawings. Plates should be presented, showing the ground covered by the applicant.



MACHINE WORK
Air Brake Shop
Boston and Maine Railroad

DETERMINING THE CANDLE POWER OF GAS
Everett Works
Boston Consolidated Gas Co.

CO-OPERATIVE STUDENTS AT WORK

FIELD PRACTICE IN LEVELLING
Surveying Class

COURSES OF STUDY

Mechanical Engineering

First Year

	Hours of Exercise*
Mathematics I	90
Descriptive Geometry I	90
Chemistry I, Lectures, Laboratory and Recitations	144
Lettering	36
English I	54
Physics I, Lectures, Laboratory and Recitations	108
Applied Mechanics I	36
Mechanical Drawing	72

Second Year

	Hours of Exercise
Physics II, Lectures, Laboratory and Recitations	108
Carpentry and Wood-working	54
Descriptive Geometry II	36
Mathematics II	36
English II	54
Mechanical Engineering Drawing	144
Mechanism	54
Valve Gears	12
Pattern Work	20
Applied Mechanics II	36
Practical Electricity	72

Third Year

	Hours of Exercise
Applied Mechanics III	90
Machine Drawing	144
Metallurgy of Iron	18
Thermodynamics	36
Mechanical Engineering Drawing and Boiler Drawing	72
Practical Electricity	72
Heating and Ventilating	18
Metal Working	48
Forging, Chipping and Filing	36
Heat Engineering	54

Fourth Year

	Hours of Exercise
Applied Mechanics IV	36
Dynamics of Machines	18
Practical Electricity	72
Engineering Laboratory	72
Machine Design	144
Locomotive Engineering	72
Foundations	18
Hydraulic Motors	36
Power Plant Design	54

Note—The courses in wood and metal working are not required of students whose practical work includes those subjects.

*Hours of exercise refers to the number of hours devoted to the subject, in the class room, during the year.

COURSES OF STUDY

Electrical Engineering

First Year

	Hours of Exercise*
Mathematics I	90
Descriptive Geometry I	90
Chemistry I, Lectures, Laboratory and Recitations	144
Lettering	36
English I	54
Physics I, Lectures, Laboratory and Recitations	108
Applied Mechanics I	36
Mechanical Drawing	72

Second Year

	Hours of Exercise
Physics II, Lectures, Laboratory and Recitations	108
Mechanism	54
Carpentry and Wood Working	54
Mechanical Engineering Drawing	72
Mathematics II	36
Descriptive Geometry II	36
English II	54
Valve Gears	12
Applied Mechanics II	36
Elementary Electricity, including Power and Its Transformations	16
Elements of Electrical Engineering	40
Methods of Wiring and National Electrical Code	16

Third Year

	Hours of Exercise
Applied Mechanics III	90
Thermodynamics	36
Machine Drawing	144
Alternating Currents	32
Alternating Current Machinery	8
Electrical Engineering Laboratory	32
Elementary Technical Electrical Measurements	13
Construction, Operation and Maintenance of Local Intercommunicating Telephones	5
Forging, Chipping and Filing	36
Heat Engineering	54

Fourth Year

	Hours of Exercise
Illumination and Photometry	6
Central Stations	15
Electric Railways	15
Electrical Engineering Laboratory	36
Principles of Dynamo Design	12
Electric Light and Transmission of Power	6
Metallurgy of Iron	18
Hydraulic Engineering	36
Machine Tool Work	72
Stationary Structures	54
Surveying	36
Applied Mechanics IV	36
Pattern Making	20
Heat Engineering	54

*Hours of exercise refers to the number of hours devoted to the subject, in the class room, during the year.

COURSES OF STUDY

Civil Engineering

First Year

	Hours of Exercise*
Mathematics I	90
Descriptive Geometry I	90
Chemistry I, Lectures, Laboratory and Recitations	72
Lettering	36
English I	54
Physics I, Lectures, Laboratory and Recitations	108
Applied Mechanics I	36
Mechanical Drawing	72
Surveying I	144

Second Year

	Hours of Exercise
Surveying and Plotting	144
Mathematics II	36
Physics II, Lectures, Laboratory and Recitations	108
Mechanism	54
Descriptive Geometry II	36
English II	54
Topographical Drawing	36
Applied Mechanics II	36
Stereotomy	36

Third Year

	Hours of Exercise
Railroad Engineering, Fieldwork and Drawing	180
Highway Engineering	18
Dynamical Geology	54
Practical Electricity	72
Applied Mechanics III	90
Theory of Structures	36
Materials	36
Structural Geology	36
Metallurgy of Iron	18

Fourth Year

	Hours of Exercise
Theory of Structures; Bridges and similar structures	90
Bridge Design	180
Foundations	18
Heat Engineering	72
Advanced Structures	36
Railroad Design	72
Practical Electricity	72
Reinforced Concrete	120
Applied Mechanics IV	36

*Hours of exercise refers to the number of hours devoted to the subject, in the class room, during the year.

COURSES OF STUDY

Chemical Engineering

First Year

	Hours of Exercise*
Mathematics I	90
Descriptive Geometry I	90
Chemistry I, Lectures, Laboratory and Recitations	144
Lettering	36
English I	54
Physics I, Lectures, Laboratory and Recitations	108
Applied Mechanics I	36
Mechanical Drawing	72

Second Year

	Hours of Exercise
Qualitative and Quantitative Analysis	216
Mechanism	54
Mathematics II	36
Physics II, Recitations, Lecture and Laboratory	108
Descriptive Geometry II	36
Practical Electricity	72
English II	54
Valve Gears	12
Mechanical Engineering Drawing	72
Applied Mechanics II	36

Third Year

	Hours of Exercise
Quantitative Analysis	126
Thermodynamics	36
Machine Drawing and Boiler Drawing	72
Applied Mechanics III	90
Heat Engineering	54
Organic Chemistry	72
Organic Chemical Laboratory	90
Technical Analysis	108
Metallurgy of Iron	18

Fourth Year

	Hours of Exercise
Organic Chemistry	36
Organic Chemical Laboratory	72
Applied Mechanics IV	36
Chemical Engineering	36
Practical Electricity	72
Industrial Chemistry	54
Industrial Chemical Laboratory	90
Elements of Electrical Engineering	40
Shop Work	72

*Hours of exercise refers to the number of hours devoted to the subject, in the class room, during the year.

SYNOPSIS OF COURSES

Mathematics I

Variation, logarithms, slide rule, exponential equations, the uses of formulas in Physics and Engineering.

Trigonometry, including circular measure, co-ordinates, trigonometric ratios, formulas, law of sines, law of cosines, solution of right and oblique triangles, applications to problems in Physics and Engineering.

Mathematics II

Co-ordinates, plotting of functions, interpolation, the straight line, curves represented by various equations, graphic solution of equations, determination of laws from the data of experiments.

Rate of increase, differentiation, determination of maxima and minima by differentiation, integration, definite integrals, determination of mean value, area and volume by integration, centre of gravity, moment of inertia, partial differentiation.

English I

This is a course in the principles of composition and letter writing. Special attention is given to spelling, punctuation and grammar.

The chief object of the work is to enable the student to write correct, lucid and easy business English.

English II

This course is a continuation of English I and is devoted to writing business letters, to descriptions of processes and machinery, and to all other possible means of enabling the student to express himself with accuracy and precision, both orally, and in writing.

Mechanical Drawing

The course extends through the first year. The instruction in Mechanical Drawing relates to the drawing instruments and materials, instrumental constructions and the drawing of irregular curves, tracing in ink, conventions, lettering, dimensioning, and working methods. The work includes several drawings of machine details.

Descriptive Geometry I

The course covers the simpler problems on the point, line,

and plane, and various constructions in the projection of solids including sections and developments.

In the latter half of the course the problems on the line and plane are completed, and the projection of solids is continued through the intersection of solids bounded by plane faces. Isometric drawings and several practical applications are given.

Descriptive Geometry II

The course is a continuation of Descriptive Geometry I and deals with single and double curved surfaces; their intersection by oblique planes, tangent planes, penetrations, development and so forth.

Lettering

The work consists of letter drawing, and stroke lettering for working drawings. The instruction is given by short lectures on the principles and processes of freehand drawing, and individual criticism. The latter part of the work is devoted to further work in letter drawing and stroke rendering, the construction of titles and title designing.

Applied Mechanics I

This is a course in the first year devoted to mechanics, with the idea of familiarizing the student with the fundamental principles of statics, stresses in frames and dynamics so that the work of the succeeding years will be more readily grasped.

Applied Mechanics II

The course comprises a study of statics, consisting of the general methods and applications of statics, including the determination of reactions, stresses in frames; of distributed forces, center of gravity; of moment of inertia, radius of gyration of plane areas and solids, including principal axes and principal moments of inertia; of kinematics and dynamics including the equations for uniform and varying rectilinear and curvilinear motion, centrifugal force, unresisted projectile, pendulum, harmonic motion, rotation, combined rotation and translation, momentum and angular momentum, center of percussion, impact, work, power and kinetic energy.

Applied Mechanics III

The course comprises a study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to tension, to compression, and to shearing;

common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moments, slopes, and deflections.

A study is also made of the theory of elasticity, including the determination of the resultant strains in any direction.

Applied Mechanics IV

The course treats of the laws of friction, including a study of the distribution of friction on shaft journals and pivots; also a study of the transmission of power by belting and by ropes, and of the friction reducing power of lubricating oils. A study is also made of the continuous girder, so planned as to apply to beams, and applications of the principles of Mechanics and of the Strength of Materials to the design of other forms of simple structures including re-enforced concrete.

Physics I

The subjects considered are general mechanics, molecular mechanics, wave-motion, electricity and optics, which topics are discussed both mathematically and experimentally. It is the purpose of the course to lay a thorough foundation for subsequent study of experimental, and technical physics. Hence it is planned with immediate reference to familiarizing the pupil with the fundamental principles of the science. The lectures are illustrated by suitable experiments.

Physics II

A course of experimental lectures which is a continuation of Physics I. In this work the student completes the study of physics started with Physics I.

Carpentry and Wood Working

This is a course designed to give students facility in the common operations of carpentering and cabinet work, together with the use and care of wood working machinery as lathes, saws, planers, etc. It is required of students whose practical work does not include such training.

Metal Working

This course is to train students in the common operations of metal working, as chipping and filing, forging, and machine work, as that done on lathes, drill presses, shapers and milling machines. It is required of those students whose practical work does not include such training.

Mechanism and Valve-Gears

This course includes a systematic study, not only of the motions and forms of the various mechanisms occurring in machines, and the manner of supporting and guiding the parts, independently of their strength, but also of the design of gear-teeth, and the study of the mechanisms found in modern American machine-tools. The course also includes the theory and practice of designing valve-gears for steam-engines, including the plain slide valve, link motions, radial valve-gears, double valves, and drop cut-off valves.

Mechanical Engineering Drawing

The instruction includes the drawing of simple machine details, such as bolts and nuts, screws, springs, keys, flanges, pipe fittings, etc.; teaching systems of dimensioning, conventional representations, and blue-printing; and the drawing necessary in connection with the course in Mechanism, such as problems in belting, quick return motions, etc. The latter part of the work consists of drawing, illustrating the class-room work in connection with the courses in Mechanism and Valve-gears including the design of cams, gear-teeth, slide-valves, double valves, the Stephenson link, etc.

Machine Drawing

The aim of the course is to teach the proper way of making the necessary dimensioned drawings for use in practice, good shop systems being adopted. The instruction includes the making of working detail and assembly drawings of machinery from measurements.

Boiler Drawing

The course is given in connection with the class-room work in boilers, and is intended not only to teach the method of drawing boilers, but to give the students more familiarity with the construction and details of steam boilers.

Thermodynamics

It includes a study of the principles of thermodynamics; a discussion of the properties of gases, saturated and superheated vapors, especially of air and steam; of the flow of fluids through orifices, nozzles, pipes and meters, a discussion of the action of the steam injector; a study of the various cycles of the hot air, internal combustion, and steam engines, of the turbine, air compressor, and refrigerator systems. These engineering

applications are treated from the physical, analytical and graphical points of view, so as to give the student a good foundation in the principles of thermodynamics, in the solution of actual heat engineering problems. The course also includes a study of the simple, compound and multiple expansion steam engine, of the different types of gas engines, of the gas producer, of compressed air and refrigerator machines, and the methods of testing such machines.

Power Plant Design

The course consists largely of drawing-room work and calculations, with such lectures as may be needed from time to time. The work of the course consists in making the working drawings necessary to show the location of boilers, engines, auxiliaries, piping, coal pockets, etc., for a power house, and also drawings and calculations of some of the details.

Heating and Ventilation

A course of lectures on the fundamental features and principles of the subject.

Dynamics of Machines

The course in Dynamics of Machines includes a number of the principal applications of Dynamics to moving machinery such as governors, fly-wheels, the action of the reciprocating parts of the steam-engine, running balance, whirling speed of shafts, etc.

Machine Design

The main object of the course is the application of principles already learned to the solution of problems in design. Each student makes a number of complete designs, such as a boiler, a large shaft with pulleys and gears, a set of couplings, a power shear, geared pump, etc. For each design the constructive details are carefully discussed; each student then makes all the necessary calculations to determine the dimensions of every part, and finally he completes the working drawings. The scope of the designs is such as to include most of the elementary principles of design, and [yet is sufficiently limited to enable the student to complete every detail, as it is believed that only by such thorough work can real benefit be obtained.

Foundations

The subjects treated in this course are as follows: building

stones and concrete, bearing power of different kinds of soil, examination of the site, designing the footings, whether of masonry, or of steel and concrete, independent piers, pile foundations, compressed air processes, freezing processes, retaining walls, together with some details of buildings for industrial purposes, constructed of steel, or of reinforced concrete.

Locomotive Engineering

This course includes a study of the form and proportions of the details of locomotives. Students make calculations of the stresses to which the various parts are subjected and thus learn to determine the strength of different members.

A study is made, also, of the compound locomotive, of train-resistance, of air-brakes, of heating cars by steam from the locomotive, of the modes of conducting locomotive tests, of the economy and performance of both simple and compound locomotives, as shown by tests, etc.

Engineering Laboratory

This consists of a series of exercises and tests on the water consumption of a steam-engine, as well as the fuel consumed, a determination of the horse power is also made.

Elementary Electricity

A course of experimental lectures taking up a consideration of static and voltaic electricity, batteries, electrolysis, magnetism and induction.

Practical Electricity

This course includes the following courses:—

Elementary Electricity
Elements of Electrical Engineering
Alternating Currents
Wiring
National Electrical Code
Intercommunicating Telephone Systems
Photometry
Electric Light and the Transmission of Power

Alternating Current Machinery

This course of lectures, recitations and problems is devoted to a careful discussion of the various types of alternating current machinery for the generation, transmission, and distribution of power. The special properties of each machine are con-

sidered for the machine as a unit, and when it is used as a part of any electrical system, some of the general considerations concerning long-distance power transmission are also included.

Elements of Electrical Engineering

This course of lectures, recitations, and problem work is devoted to the fundamental principles of Electrical Engineering. It includes a discussion of the laws and properties of electric and magnetic circuits, followed by an introduction to the study of variable currents and a treatment of the principles of direct current machinery. The solution of problems illustrating the engineering principles involved forms an important part of the instruction. A part of the course is devoted to the theory of direct current dynamos and the principles involved in their testing.

Alternating Currents

This course is virtually a continuation of the course in Elements of Electricity and concerns itself with the general theory of alternating current circuits, and the application of the principles to various engineering problems. In connection with the work, considerable importance is attached to the solution of problems selected with reference to their engineering application.

Electrical Engineering Laboratory

A course devoted to the study of direct-current machinery. The tests include the determination of characteristics, efficiency, regulation, and heating, and are supplemented by laboratory conferences.

Elementary Technical Electrical Measurements

This course is designed to familiarize the student with the most important electrical instruments and methods of measurement.

Intercommunicating Telephones

A course of lectures in the construction, operation and maintenance of factory intercommunicating telephone sets.

National Electrical Code and Wiring

A study of the various approved methods of wiring together with the specifications of the National Electrical Code.

Illumination and Photometry

A course of lectures and laboratory exercises dealing with

the engineering problems in the production, measurement and utilization of artificial illumination.

Central Stations

This course consists of lectures and assigned readings treating of the design, construction, and operation of electric power generating stations, including problems of management and questions of cost.

Electric Railways

A course of lectures including a discussion of the construction, equipment, and operation of different types of electric roads, together with related problems in power transmission and generation.

Electrical Engineering Laboratory

The work includes such tests as efficiency, heating, regulation, and determination of characteristics for alternating current machinery. The work in the laboratory is supplemented by conferences.

Principles of Dynamo Design

A short discussion of the materials of construction and methods of armature winding is followed by the electrical and magnetic calculations for a direct-current compound dynamo and a transformer.

Electric Light and Transmission of Power

A course considering the various problems of electric lighting and the electric transmission of power. The work consists of lectures and quizzes.

Surveying I

This course consists of a series of lectures, supplemented by exercises in the field and the drawing-room. The student is taught the use of the chain, tape, compass, solar compass, and transit, and the use of various forms of levelling instruments. The work in the drawing-room consists in making the computations which arise in the work of the surveyor, in making scale drawings, profiles, and contour maps from notes taken in the field, and in studying the application of contour maps in the solution of problems of drainage, road location, landscape engineering, etc. The text-book used is the Principles and Practice of Surveying by Professors Breed and Hosmer, Vol. I.

Surveying II

This course consists of lectures and work in the field and the

drawing-room. The instruction includes the use of the stadia and plane table in topographic surveys, of the sextant in hydrographic and astronomical work, of the barometer for determining differences of elevation, of the slide rule for computations the construction of stadia diagrams, and the making of topographic maps. The text-book used is the Principles and Practice of Surveying by Professors Breed and Hosmer, Vol. 2.

Topographical Drawing

This course consists of two hours per week in the drawing-room devoted to the study of the different conventional signs employed in making topographical maps. Each student is required to make a number of plates, and to become reasonably proficient in the preparation of such maps. Particular attention is given to the study of contour maps, and the solution of problems relating thereto.

Stereotomy

A series of exercises in the applications of Descriptive Geometry to the making of drawings for masonry structures such as intersecting walls and arches, abutments, piers, and culverts.

Highway Engineering

This course comprises an outline of the principles governing the location, construction and maintenance of roads, and the construction and maintenance of the various kinds of pavements for city streets.

Dynamical Geology

This course is an introduction to earth movements and the various terrestrial applications of solar energy. The greater geological processes, erosion, sedimentation, deformation, and eruption are discussed by lectures and lantern slides.

Theory of Structures

This course is devoted to class and drawing-room work in studying the loads, reactions, shears and moments acting upon structures of various kinds as roofs and bridges.

Materials

This course takes up a consideration of the properties of the various materials used by the engineer such as stone, brick, cement, concrete, wood, iron and steel.

Advanced Structures

This course treats of the computation and design of con-

tinuous girders, movable bridges and skeleton frames for buildings. Only the more simple cases are considered.

Heat Engineering

This is a continuation of the course in Thermodynamics in which the theoretical considerations of that course are applied to practical problems.

Hydraulic Motors

A series of exercises mainly recitations based upon a text-book, so as to embrace the laws of flow in open channels and of the dynamic pressure and work of water flowing over curved surfaces. The time is principally given, however, to a study of impulse wheels and reaction turbines, with reference to their proper construction, regulation, and testing, and to the various sources of loss of energy in their operation.

Hydraulic Engineering

This course is intended to illustrate the application of theory to practice, particularly along the lines of water power engineering, including the problems involved in a study of stream flow, storage and the general arrangement of water power plants.

Pattern-Work

The course includes instruction in Wood-turning having special application to Pattern-work, an illustrated discussion of the principles of moulding to explain clearly and show reasons for "Draft" on patterns and methods of allowing it, instruction in the use and making of core-boxes, and methods of building up patterns.

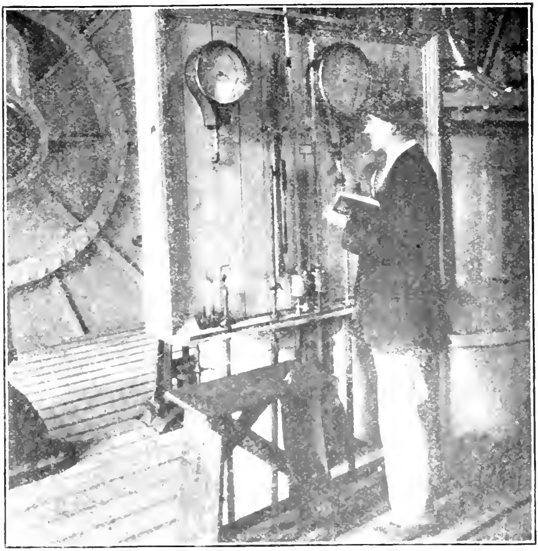
Structural Geology

This course consists of lectures on the broader structural features of the earth's crust, and the application of the principles of Structural Geology to practical engineering problems; and field and laboratory exercises in the study of the more common rocks, structures, and topographic forms.

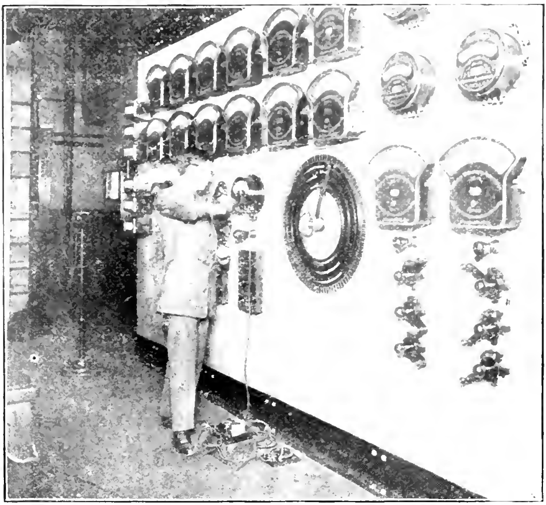
Railroad Engineering

The course includes:—

Operations in location of a railroad: reconnoissance, preliminary survey, location. Reconnoissance: purpose governing topographical features; how carried on, instruments used. Preliminary survey: purpose, grades, pusher grades, length of line, curvature, rise and fall, organization of party, field work,



READING GAUGES
Everett Works
Boston Consolidated Gas Co.



CHECKING VOLTMETERS
Head Place Station
Edison Electric Illuminating Company

form of notes, plotting preliminary map. Location survey: field location, paper location, field work, form of notes. Simple curves; functions, degree of curve, relations between the primary functions, use of tables for curves, deflection angles, deflection distances, offsets from tangents, field methods, ordinates. Simple curve problems: substituting curves ending in parallel tangent, miscellaneous problems, obstacles on tangent and curve. Compound curves: problems, changing P. C. C. to end in parallel tangent, substitution of compound for simple curves. Reversed curves: connecting parallel tangents, connecting non-parallel tangents. Parabolic curves: horizontal, vertical curves. Turnouts, parts of turnouts, stub switch, split switch methods, connections of parallel tracks, yard computations, staking out turnouts. Turnout tables. Y tracks and crossing frogs: computation and layout of Y tracks, crossing frogs for straight and curved tracks. Easement curves: cubic spiral, Searle's spiral, methods of offsets and of reflection angles. Application to compound and reverse curves. Earthwork: slope stakes, cross-sections, different forms of sections. Methods of computing earthwork; averaging end areas, prismoidal formula, prismoidal correction and other methods. Correction for curvature, burrow pits. Earthwork tables and diagrams: their construction and uses. Haul, mass diagram. Yard design: freight yards, passenger yards, yard accessories, round houses, coal tracks, ash pits, etc. Track: track laying, ballast, rail, joints, drainage. Train resistance: level tangent resistance, curvature, grades. Economics: cost of distance, of curvature, of maximum grade, of rise and fall. Abolition of grade crossings: general problems. special problems, Chicago method of handling traffic, methods of handling work. Railroad signalling: block signals, interlocking signals.

Drafting

The course will be supplemented to some extent by drafting and by railroad designing.

Fieldwork

If necessary to illustrate the principles involved in the course, exercises will be given in the field on a few Saturday afternoons in the spring.

Reinforced Concrete

A course consisting of lectures and drafting, in which

instruction is given in the theoretical and practical principles involved in the design of structures of plain and reinforced concrete. The course includes a study of the simple reinforced concrete beam, the design of slabs, I-beams, columns, footings, retaining walls and arches. Instruction is given by means of lectures and text-books, in conjunction with which each student is given practical problems in design to be worked out in the drawing room.

Bridge Design

A course in which the students are instructed in the design of structures of wood, stone, and metal. Each student is given a set of data, and is required to perform all the computations and to make designs and working drawings for several structures, such as a plate girder bridge, a wooden roof truss, and a riveted or pin bridge. His work is criticized as it progresses.

Railroad Design

A drawing room course including problems in contour location; the proportioning of culverts and waterways; the design of track work, yards, station grounds and other practical railroad problems.

Chemistry I

The fundamental principles of the science are taught in connection with the descriptive chemistry of the non-metallic elements. The lectures are designed to preceed the work of the laboratory, in which the students are expected to verify and illustrate the principles and facts which have been discussed in the lecture room. Careful manipulation, thoroughness in observation, accuracy in arriving at conclusions, and neatness in note-taking are required of each student, and the training afforded by this course is considered of value to all students whatever Course they may later select; for students of the Course in Chemical Engineering it lays the necessary foundation for subsequent chemical study.

Chemistry II. Analytical

A practical course in qualitative analysis for the separation and identification of the common metallic elements and the acids. Each student is also required to make a complete and accurate analysis of various mixtures, alloys and chemicals used in manufacturing. The laboratory work is supplemented by a course of lectures and conferences, devoted to a general study of the properties of the common metals and their compounds.

Chemistry III. Quantitative Analysis

A course in gravimetric and volumetric analysis. Special attention is given to accurate manipulation, the preparation of standard solutions, the calibration of instruments and to the principles of stoichiometry. The laboratory work is supplemented by a course of lectures and conferences.

Chemistry IV. Organic

A course consisting of lectures and conferences on the principles of organic chemistry as illustrated by the methane and benzene derivatives.

The student is required to prepare in the laboratory a number of organic compounds, selected to show characteristic organic reactions and to give training in the practical separation and purification of organic substances. After this synthetic work the students are given a practical course in organic analysis.

Industrial Chemistry

This course consists of a series of lectures and recitations upon the more important technical chemical processes, including those of Metallurgy. Much attention is given to the general operations common to many industries, such as crushing, grinding, lixiviation, filtration, evaporation, distillation, crystallization, etc., and to the details of various types of apparatus used for carrying on these processes. Some of the more important manufacturing industries, such as the production of alkali, fertilizers, glass, pigments, cement, soap, explosives, paper, as well as wood distillation, the refining of petroleum etc., are also considered in detail.

Metallurgy of Iron

A series of lectures taking up a general consideration of the Metallurgy of Iron and Steel. The introductory part is devoted to a discussion of the physical and chemical properties, and the constitution of cast iron, wrought iron and steel. This is followed by a more extended treatment of the production of cast iron, wrought iron, Bessemer, open-hearth, cement and crucible steel, and of foundry work. In the discussion of the different processes, principles of manufacture are made prominent.

Technical Analysis

A course consisting mainly of laboratory practice in typical methods of water analysis and gas analysis and, so far as the time permits, the study of procedures applicable to the proximate technical analysis of industrial products.

Equipment

Note.—At the time of going to press the buildings to contain these various departments are in process of erection to be completed in the fall of 1912.

DEPARTMENT OF PHYSICAL TRAINING

Our new gymnasium with all the latest modern equipment will give ample accommodation for all students.

There will be a running track on the grounds adjoining, together with tennis and hand ball courts; also a large natatorium where swimming will be taught by competent instructors.

MECHANICAL DEPARTMENT

Mechanical Laboratories

There will be a completely equipped steam engineering laboratory in the new building where students may make practical boiler and fuel tests, as well as study steam engineering practice. In addition to a complete modern power plant used for lighting and heating the buildings, there will be several engines used wholly for instruction purposes. The students also have the use of the equipment of our Automobile School, thus giving opportunity to study the most advanced ideas in gasoline engine practice.

MECHANICS ARTS LABORATORIES

There will be two large laboratories, one for metal work and the other for wood work. These will be for the use of those students whose practical work does not include courses of this character. The metal working laboratory is now in use in connection with the Automobile School and includes: one large and one small drill press, one large and one small engine lathe, a high-speed lathe, emery wheel, shaper, grinding machine, electric drill and milling machine, together with the necessary equipment for complete machine, and bench work instruction.

The wood working laboratory will include planers, saws, steam boxes and benches, together with all necessary equipment for complete instruction in practical woodworking.

LIBRARIES

There will be in connection with the School a professional library containing books pertaining to both the school work of the boys and to their practical work. In addition to this there will also be current periodicals on engineering and scientific

subjects for their exclusive use. All members of the School are entitled to take books from the Boston Public Library, and this offers a very unusual opportunity to our non-resident students.

DEPARTMENT OF CHEMISTRY

The Chemical Laboratories will have accommodations for more than one hundred and fifty students. The Department will comprise three laboratories, a lecture room, a reference room, a combustion room, a balance room, office and supply room. These laboratories will be equipped with the most modern apparatus for all lines of chemical work. For analytical work, there will be every facility for rapid and accurate work. In addition to this there will be all necessary apparatus for fuel and gas analysis as well as for a complete course in organic chemistry. The equipment of the laboratories will include vacuum and pressure apparatus, balances, electrolysis circuits, combustion furnaces, gas absorption and explosion apparatus, sampling apparatus and flue thermometers and gas calorimeter. There will be also testing machines for oils, viscosimeters, and different sorts of flash point apparatus. A chemical museum will be connected with this department where will be kept specimens for purposes of illustration.

PHYSICS DEPARTMENT

There will be a large laboratory devoted entirely to Physics, together with a lecture room.

The laboratory will be equipped with the most improved devices for instruction in general physical measurements including the mechanics of solids, liquids and gases, light and heat.

ELECTRICAL DEPARTMENT

The laboratory is well equipped with apparatus and possesses a set of instruments for teaching the principles of measurement including slide-wire and Carey-Foster Bridges, Laboratory Bridge, Portable Testing Set, Potentiometer, apparatus for testing insulation, together with a large assortment of minor apparatus which can be combined in many ways for the exigencies of any particular test which may be desired for some special instruction.

The equipment of instruments for practical measurement is very complete, consisting of a large number of Weston D. C. ammeters and voltmeters of various types ranging in size from 1 to 100 amperes and from 3 to 750 volts for use with direct currents, many of the ammeters being fitted with interchange-

able shunts, and the voltmeters with extension coils largely increasing their capacity and usefulness.

For alternating current work there are six Weston portable ammeters and eight Westinghouse switchboard ammeters, all fitted with current transformers for 6600 volt circuits with 50 and 25 ampere primaries and 5 ampere secondaries, also three with 60 ampere secondaries and three with 250 ampere secondaries. Also 4 Weston portable voltmeters and six Westinghouse switchboard voltmeters with 150 volt scales and all supplied with potential transformers of 10 and 20 to 1 ratio. Two G. E. switchboard type recording three phase wattmeters, and one Westinghouse round pattern one, three single phase induction type watt hour meters, several General Electric iron clad indicating wattmeters, and a pair of high torque General Electric Test meters.

There is also a large and complete equipment of auxiliary apparatus, as synchronizers, power factor indicators, frequency indicators, speed counters, tachometers, Proney brakes, and the many minor pieces of apparatus needed in practical testing and operating of machinery.

There are among machines:

A pair of specially made, matched machines, arranged to run either as single-phase, two-phase or three-phase generators or motors, as well as synchronous transformers, double current generators or, on the D. C. side as shunt, series or compound generators or motors, and also as three wire generators on the Dobrovolsky plan.

Two specially matched, 18½ horse, series motors fitted to a K-10 G. E. series-parallel controller, with brakes, etc., for efficiency and other tests.

A 60-Horse power 60 cycle single phase 500 volt alternator, a smaller (7½-Horse power) special G. E. 60 cycle 250 volt alternator revolving field, tapped for either 1, 2, 3, 6 or 12 phase currents and supplied with special *rotors* changing it into a synchronous, or induction motor of three types as well as into a frequency changer, a Thomson-Houston Inclined coil, compound generator, a 25-Horse power Westinghouse Compound generator, which can also be operated as a motor, and fifteen other direct and alternating motors of different types and sizes, these being used mostly for individual work.

There have recently been added three 16 kilowatt General

Electric Constant Current Transformers with 3.5 ampere secondaries and 2200 volt primaries, together with the transformers necessary to operate them from the large 60 kilowatt generator. Also a 2½-horsepower General Electric Induction motor for 60 cycles and 220 volts.

The laboratory equipment is as will be readily seen very complete and suitable for teaching in a thoroughly effective manner, while the few remaining lacunæ are being readily filled up. The total value of the present equipment being not far from $12000.

In addition to the foregoing equipment we have been informed by the officials of the Massachusetts Institute of Technology that it could very probably be arranged for us to make use of their unexcelled laboratories and apparatus when we needed them, at times when they were not in use by their own classes, thus enabling our students to avail themselves of the finest experimental equipment in the country. As soon as our courses require more equipment than we have, steps will be taken to bring about the completion of negotiations to this end. At the time of going to press our evening school classes are using the Chemical Laboratories of the Institute, and it ought not to be a far step to a similar arrangement for our day work.

POST-GRADUATE OPPORTUNITIES

Students of good ability, on completing the Co-Operative Course, have the opportunity to attend the Massachusetts Institute of Technology if they care to, and by taking special extra work in the Co-Operative School during their course they could reasonably expect to complete the Technology work and get their degree in two years. Through conference with officials of the Institute, it has been found that those of our courses equivalent to theirs will probably be accepted in place of theirs, and the student given a clear record in such subject, either by passing an examination, or at the discretion of the head of the Department. Since a large number of our courses are covering the same ground as those at the Institute, a capable student should be able at the end of his course to get a clear rating at Technology for at least the equivalent of two years work there. This offers a rare opportunity for an ambitious capable young man to get the most valuable kind of an education at small cost.

General Departments

DEPARTMENT OF PHYSICAL WORK

Albert E. Garland, M.D., B. P. E. Director

The Physical Department is under the best supervision and the aim is to better fit men for their life work by increasing their efficiency through exercise. We offer: Well equipped gymnasiums, Recreative, Hygienic, and Educational Gymnastics. Numerous classes the year round. Shower, steam and electric baths. Best instruction. Medical direction. Hand ball courts. Basket ball, baseball and athletics.

DEPARTMENT OF RELIGIOUS WORK

Edwin W. Peirce, Director

In order that a young man may secure a well-balanced development and attain a spiritual foundation for successful life work the Association advises each member in planning his schedule to enter into one or more of the following activities:—

Bible Study, Sunday Meetings of Men, Personal Service Groups, and The Twenty-Four-Hour-A-Day Club.

(Ask for Bible Institute catalog and other printed matter.)

DEPARTMENT OF SOCIAL WORK

David M. Claghorn, Director

The attention of members is called to the many opportunities in the Association for social service, and the following social features.

A Newly Equipped Game Room. The Popular Novel Club.
The Association Congress. The Land and Water Club.
Popular Social Evenings.

DEPARTMENT OF EMPLOYMENT

Frederick W. Robinson, Director

The Employment Department, is in actual practice, a clearing house for young men seeking work, and employers who wish to engage reliable help. From 5000 to 8000 men apply every year. Members of the Association are given 25 per cent discount from the legal rates and special effort is made to notify them when good positions are open.

BOYS' DEPARTMENT

Don S. Gates, A. B., City Secretary

The physical, social, employment, and religious advantages offered to boys from twelve to eighteen years, are similar to those offered to men as stated above. Membership dues for the boys range from one to six dollars according to the privileges desired. Boys' work is also organized in the North End, the South End and Roxbury.

C.S.EL.

THE CO-OPERATIVE ENGINEERING SCHOOL

CATALOG
1913-1914

PUBLISHED BY THE
EDUCATIONAL DEPARTMENT
OF THE
BOSTON YOUNG MEN'S CHRISTIAN ASSOCIATION
HUNTINGTON AVENUE, BOSTON, MASS.
(288 St. Botolph Street, until June 1, 1913)

CATALOG

OF THE

CO-OPERATIVE ENGINEERING SCHOOL

1913-1914

CATALOG

OF THE

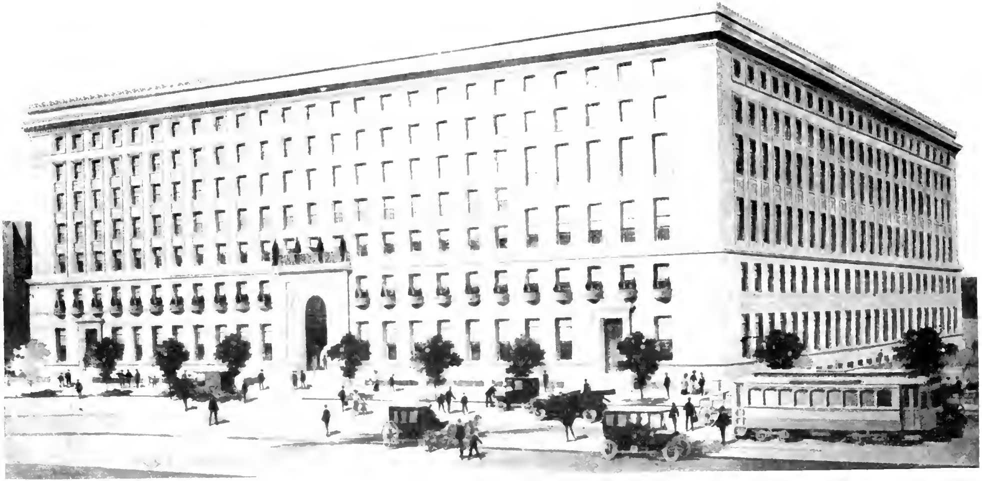
INSTRUCTING STAFF

TOGETHER WITH

A Statement of the Requirements for Admission

AND

A Description of the Courses of Instruction



OUR NEW HOME

The above cut represents the new Association Building now under process of construction on Huntington Ave. It contains among other features, school accommodations of the very best, a fine gymnasium, bowling alleys, swimming pool, cafe, dormitories, shops and laboratories, camera club rooms, social and recreative rooms and auditorium.

The building will be ready for occupancy June 1, 1913.

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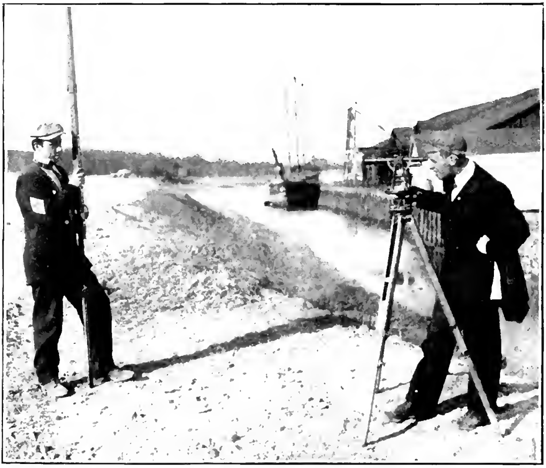
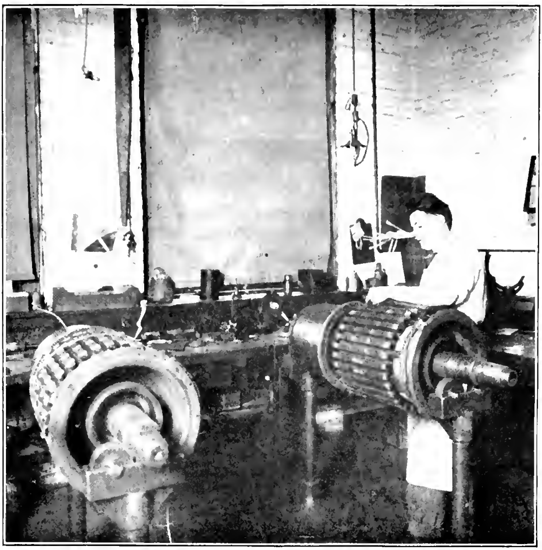


TAKING LEVELS FOR A CROSS SECTION
Weymouth Landing
Aspinwall and Lincoln, Civil Engineers



INSERTING COILS IN 150 HORSE-POWER ARMATURE
Armature Shop
Boston Elevated Railway Company

Calendar

1913

February 22, Saturday
Washington's Birthday (School exercises omitted)

April 19, Saturday
Patriots' Day (School exercises omitted)

May 26 to June 7
Final Examinations

June 7
Close of School year

June 8 to September 14, inclusive
Summer vacation

June 26-27, Thursday and Friday
Entrance Examinations of Co-Operative Engineering School

July 1-12
Practical work commences for First Division

September 10 and 11, Wednesday and Thursday
Second Entrance Examinations

September 15
School work of year 1913-1914 begins

September 15-20
Practical work commences for Second Division

October 13, Monday
Columbus Day (School exercises omitted)

November 27, Thursday
Thanksgiving Day (School exercises omitted)

December 22-27, inclusive
Christmas Recess (School exercises omitted)

1914

February 23, Monday
Washington's Birthday (School exercises omitted)

April 20, Monday
Patriots' Day (School exercises omitted)

May 30, Saturday
Decoration Day (School exercises omitted)

June 1-13, inclusive
Final Examinations

June 14-September 13, inclusive
Summer vacation

June 11 and 12, Thursday and Friday
Entrance Examinations of Co-Operative Engineering School

July 1-11
Practical work commences for First Division

September 9-10, Wednesday and Thursday
Second Entrance Examinations for Co-Operative Engineering School

September 14, Monday
School work for year 1914-1915 commences

September 14 to 19
Practical work for Second Division commences

Officers of Administration

General Administrative Officers

ARTHUR S. JOHNSON, *President*
JACOB P. BATES, *Vice-President*
HAROLD PEABODY, *Recording Secretary*
FRANCIS B. SEARS, *Treasurer*
GEORGE W. MEHAFFEY, *General Secretary*

Educational Committee

JOHN ROUSMANIERE, *Chairman*
WILLIAM E. MURDOCK
ALBERT H. CURTIS
MORGAN L. COOLEY
GEORGE P. HITCHCOCK

Educational Administrative Officers

FRANK P. SPEARE, *Director of Education*
GALEN D. LIGHT, *Asst. Director of Educ. and Bursar*
H. W. GEROMANOS, *Supt. of Evening School System*
IRA A. FLINNER. *Supt. of Day School System*
CHARLES B. GRAY, *Secretary*

Advisers

The following gentlemen have agreed to act in an advisory capacity on the more important executive matters of the school where their service can be of the greatest value to us.

Dr. Richard Maclaurin, President of Massachusetts Institute of Technology
Charles A. Prosser, Secretary of National Commission on Industrial Education
James P. Munroe, Secretary of Massachusetts Institute of Technology Corporation
William McKay, General Manager, New England Gas & Coke Co.
Paul Winsor, Chief Engineer, Boston Elevated Railway Company

Officers of Instruction

H. W. GEROMANOS, S.B., Mass. Inst. Tech.
DEAN

ROYALL D. BRADBURY, S.B.
Structural Steel

JAMES BROUGH,
Industrial Design and Lettering

A. L. CHESLEY
Chemistry

W. E. COOKE, JR.
Alternating Current Laboratory

J. A. COOLIDGE, S.B.
Mathematics and Physics

H. E. DEXTER, S.B
Alternating Currents

LOREN DOWNS, S.B.
Electrical Engineering

D. V. DRISCOLL
Chemistry

CARL S. ELL, S.B., M.S.
Civil Engineering

A. L. GARDNER, S.B.
Mechanical Engineering

H. W. GEROMANOS, S.B.
Chemistry and Metallurgy

E. D. HAYWARD
Stereotomy

FREDERICK C. HOSMER, A.B.
English

JOHN W. HOWARD, S.B.
Surveying

ERVIN KENISON, S.B.
Descriptive Geometry

J. F. NORTON, S.B., Ph.D.
Chemistry

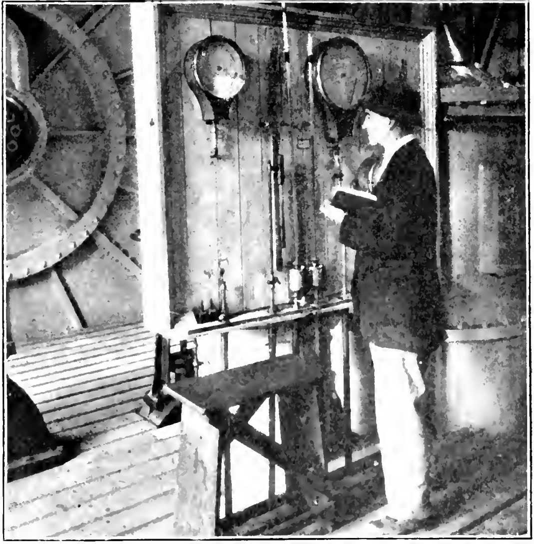
THOMAS E. PENARD, S.B.
Mathematics

CHARLES H. RESTALL, S.B.
Railroad Engineering

W. LINCOLN SMITH, S.B.
Electrical Engineering

ELLWOOD B. SPEAR, A.B., Ph.D.
Chemistry

At the time of going to press, our annual election of instructors for the year has not been held, and so it is impossible to publish a complete list of the faculty for 1913-1914.



READING GAUGES
Everett Works
Boston Consolidated Gas Co.

CHECKING BATTERY AMMETERS
Atlantic Avenue Station
Edison Electric Illuminating Company

General Information

It has generally been conceded that where the practical and the theoretical elements of education can be taught simultaneously, the greatest good is derived by the student, and efforts are being made in all departments of education to accomplish this greatly desired end.

Technical school instruction, depending on class room work and laboratories, must always lack some of the vital characteristics of an actual manufacturing plant, owing to the fact that one is for educational purposes, while the other is operated for dividends. It is this latter fact that gives the Co-Operative School idea one great advantage over our usual educational plan. Instead of protecting the student, and training him for several years, for a line of work to which he may later find himself to be entirely unfitted, the Co-Operative School at once puts the boy to work in a commercial plant. There he learns life in its vital issues, as well as the problem of getting along with men; thus early finding out whether he has made a wise, or unwise, choice of his life work. This training, too, shows him the use and value of his school work, and finally gives him an unusual opportunity to acquire from actual experience that rare thing, *executive ability*, without which his life probably will always be spent on the lower levels of industry.

That the young men of New England might have an opportunity to attend such a technical school, where both practice and theory are correlated, and at the same time be enabled to defray a large part of the expense of their education by the returns from their practical work, the Co-Operative Engineering School of the Boston Young Men's Christian Association was started in 1909.

This school has now been in operation for four years, and the continually increasing interest in it, as well as its rapid and steady growth, show that it was much needed to fill a place that is filled by no other school in this vicinity.

OBJECT OF THE SCHOOL

The fundamental aim of this school is to train, for positions in Engineering work, young men who are unable to attend the highest grade technical schools, or colleges. Thus they are enabled to advance farther and more rapidly in their chosen work than they could reasonably expect to do without further education than that of a high school course. The training is not in any sense that of a trade school, nor is it exactly that of our best scientific schools, but it stands between the two. The work done is that of a regular technical school, of high standards, but only the essential subjects are taken, and they, only so far as they will have a direct bearing on the life work of the student. In other words, it is a limited technical training of high grade. The fact that most of our instructors are graduates of, or instructors in, the Massachusetts Institute of Technology, will show the character of work being done.

At present there are four lines of Engineering work being given, and the end sought is to give to students who have already had a high school preparation, or its equivalent, a good training in the fundamental sciences of Mathematics, Chemistry, and Physics, and in the important applications of the principles of these sciences to the several branches of engineering. More stress is laid on the development of the ability to apply the acquired knowledge to new engineering problems, than to the memorizing of a multitude of details and very abstract theory, which, while valuable, cannot be gone into too deeply in a course of this type.

The class room instruction is given to small sections, and in the drawing rooms and laboratories, the students receive a great deal of personal attention. The independent solution of assigned problems forms a large part of nearly all courses.

The courses differ from those of many schools, in that a student is not permitted a wide range of subjects from which to choose, in the belief that better results are obtained by prescribing, after the student has selected the line of work for which he desires to prepare himself, the principal studies which he is to pursue.

PLAN OF OPERATION OF THE SCHOOL

To illustrate the idea of the curriculum at the school, take for instance, the case of a young man "A" who desires to take our Mechanical Engineering course.

"A" is assigned to one of the plants of a firm that is co-operating with us. Here he is put to work and spends that week working in the shop. The next week, "B" his mate, who has spent the first week in the school, takes "A's" place in the shop, and "A" puts in the week at school. Thus the work goes on, the two men exchanging places at the beginning of each week. The studies pursued in the course have a direct practical bearing on the outside work, with the exception of a few courses added, because of the aim which we have, to produce a better citizen, as well as a better employee. The courses given have been decided upon after conference between the co-operating employers and the school authorities, and are the result of the best ideas of both. The subjects are taught in a practical, not in an abstract, or a theoretical, way. Thus, in mathematics, instead of teaching algebra, analytic geometry and calculus as so many separate subjects, they are correlated and taught as instruments for the solution of practical problems arising in engineering work. The aim throughout the course is to give it practical bearing and yet have it complete and thorough in all the needed essentials.

Correlation of Practical and Theoretical Work

The outside work of the student is as carefully planned as that at the school, and it is progressive. The employers who co-operate with us generally agree, where practicable, to employ the boys in all the different departments of their establishments during their periods of practical duties; this training is just as complete as the school work, and is just as thorough. Where possible, the course of the learner is from the handling of the raw material to the shipment of the finished product. This practical training includes the use of the machines, as well as the executive duties of the plant, so that at the end of his course the graduate may not only know how to do things, but also why they are done in certain ways, and he may, we hope, be of value in improving methods of work.

Co-operating Firms:

The following firms are co-operating with us at the present time and giving employment to our students:—

Boston Elevated Railway Co.
Boston & Albany Railroad Co.
Mechanical Engineering Department
Civil Engineering Department
Boston & Maine Railroad Co.
Mechanical Engineering Department
Civil Engineering Department
Boston Consolidated Gas Co.
Aspinwall and Lincoln, Civil Engineers
New York, New Haven & Hartford Railroad Co.
Bay State Street Railway Co.
Civil Engineering Department
Mechanical Engineering Department
Edison Electric Illuminating Co.
A. D. Little Co., Inc.
Engineering Chemists
H. F. Bryant, Civil Engineer
Simplex Electric Heating Co.
Simplex Wire and Cable Co.
Frank E. Sherry, Civil Engineer

Several other firms have agreed to co-operate with us, but the demand for our boys, this year, was such that we were unable to fill all the positions offered.

Thus far, we have secured new positions for our students as the growth of the School has demanded. However, to be at all sure of work in his chosen branch of engineering, an applicant should file his application early, as the number of positions in any one line is necessarily limited.

SCHEDULES OF PRACTICAL WORK

Below are typical schedules of practical work that have been prepared for our students by some of the companies which are giving our boys employment:—

BOSTON ELEVATED RAILWAY CO.

First Year

Six months, pit work in carhouse.
Six months, armature room.

Second Year

Twelve months, machine shop work.

Third Year

Six months, mechanical drafting room.
Six months, power station work.

Fourth Year

Six months, line department.
Six months, electrical engineer's department.

BOSTON & MAINE RAILROAD COMPANY

Six months, air brake shops.
One year, erecting work.
One year, machine shop.
One year, engine house repairs.
Six months, drafting room and testing work.

BOSTON CONSOLIDATED GAS CO.

Nine months, data takers.
Three months, office.
Three months, pipe fitter's helpers.
Three months, pump man's helpers.
Three months, blowers and exhausters.
Three months, laboratory.
Three months, boiler room.
Three months, generator house.
Three months, steam fitters.
Three months, machine shop.
Three months, assistant engineers.
Six months, laboratory.
Three months, distribution department.

SIMPLEX WIRE AND CABLE CO.

Six months, Insulating Department.
Six months, Braiding Department.
Six months, Cable Shop.
Six months, Twisting Department.
Six months, Machine Shop Construction Gang.
Six months, Electrical Construction Gang.
One year, Testing Room.

The above programmes show what the boys do in their practical work, and the courses of study pursued at the school show what they do along academic lines. It will be seen that there is a considerable degree of correlation between theory and practice in the work they take up. The men under whose supervision the boys have been in their outside work, are practically unanimous in approval of our plan, and speak highly of the enthusiasm, earnestness and intelligence the students have shown in the performance of their duties.

Attitude of Co-Operating Firms

Almost all the concerns which co-operated with us last year, took one, or more, additional pairs of our students this year, which in itself is significant of their attitude toward our plan.

Earnings

For the practical work the student does, he is paid a certain amount per hour at the start, and a definite increase per hour after completing fixed periods of service. The sum earned is more than enough to pay the tuition and the necessary expenses of schooling, but will not cover the cost of living.

In some cases the boys are paid at a higher rate than is called for by their schedule of pay, but that is a courtesy of the company that gives them employment and is not in any way to be expected as a regular thing. The co-operating firms may make any salary schedule they desire, so long as it does not fall below that originally agreed upon.

The companies which co-operate with us, agree to pay our students ten (10) cents per hour during their first year of service; twelve (12) cents per hour during the second year; fourteen (14) cents per hour during the third year, and sixteen (16) cents per hour during the fourth year.

Basing the earnings on this scale, the student will earn from five (5) to six (6) dollars per working week during the first year, and an increase of approximately one (1) dollar per working week, for each succeeding year of the four. As there are about thirty weeks of work per year, the earnings will be from one hundred and fifty dollars, upwards.

Expenses

As the earnings of the students average from $150 to $200 a year, while their entire expense for school and membership in the Y. M. C. A. is not over $110, there is a considerable balance for incidentals.

Relation of the Co-Operative School to High Schools

This school is peculiarly adapted to the high school graduate who, although financially unable to continue his studies further, still has the ambition and ability to get ahead if given the opportunity. Thus boys, being graduated from high school, can still live at home, but spend their time in fitting themselves for something better in the future.

Number of Students

The number of positions at our disposal in any one branch of engineering is necessarily limited, and so the number of students who can work part-time in that line is also limited.

In consequence of this, those students who apply first, will get first consideration in the matter of positions, and those who wish to enter should present their applications as soon as possible.

Those applicants who apply for admission to the School too late to be assigned to practical work, may attend the School every week, or every alternate week, as they may wish, and will be assigned to practical work as soon as an opening occurs.

Outside Interests

A moderate participation in social and athletic activities is encouraged by the Faculty, although a standard of scholarship is required of the students which is incompatible with excessive devotion to such pursuits.

Four-Year Courses

Regular four-year courses leading to a diploma, are offered in the following branches of engineering:—

Mechanical Engineering
Civil Engineering
Electrical Engineering
Chemical Engineering

Descriptions of these courses and schedules showing the subjects of instruction included, will be found on succeeding pages.

Summer Schools

There are day and evening summer preparatory schools conducted by the Educational Department of the Association, and students having entrance conditions, or requiring further preparation for the entrance examinations, may avail themselves of this opportunity to cover the desired work.

Those of our students who fail to pass in any of their school work may be permitted to take up the study in the Summer School conducted by the Institute of Technology, provided of course, that Institution is offering such a course. Those students desiring this privilege should consult the Dean, as special permission must be obtained to attend many of the courses.

Physical Training

Those students who desire gymnasium instruction may obtain the same by the payment of the gymnasium fee in ad-

dition to their tuition. This will entitle the student to exercise with the regular classes as well as to use the gymnasium at other times.

Requirements for Admission

Detailed information in regard to the requirements for admission to the courses of instruction in the School will be found on succeeding pages. In general, the preparation necessary to enable an applicant to pursue one of the Courses, corresponds with that given by good high schools in their four years' course.

School Year

The term begins September 15th, 1913, but on succeeding years the school year will commence on the second Monday in September. The school exercises are suspended on legal holidays and for one week at Christmas.

Registration

Each applicant for admission to the School is required to fill out a blank whereon he states his places of previous education, as well as the names of persons to whom reference may be made in regard to his character and training. A deposit of one (1) dollar is required when this application blank is filed. Should the applicant be rejected, this fee will not be returned to him: should the application be approved, the fee will be applied toward his tuition.

On approval of the application, the applicant is required to fill out an attendance card, blank forms of which will be supplied. A ten-dollar registration fee, nine dollars in addition to the one deposited with the application, is to be paid at the same time. This fee is also credited to the student as part payment toward his tuition.

Before a student will be put to work, or allowed to attend classes, this initial fee of ten (10) dollars must be paid.

This fee is non-returnable, once the applicant has passed the entrance requirements and been accepted by the School.

An additional twenty(20)dollars is required to be paid before any books, or supplies, are issued to him.

Attendance

Students are expected to attend all exercises in the subjects they are studying, unless excused by the Dean. With the

exception of one hour in the middle of the day, exercises are held, and students are, in general, expected to devote themselves to the work of the school between 9 A.M. and 5 P.M. There are no exercises on Saturday after 12 N.

Status of Students

The ability of students to continue their courses is determined in part by means of examinations; but regularity of attendance and faithfulness to daily duties are considered equally essential.

Any student failing to make a satisfactory record in either school, or practical work, may be removed from his position in practical work.

Examinations

Examinations in all subjects are held at the close of each school year, in May and June, and cover the work done during the year. All students who maintain a year's average of 80% or over, in their daily work and informal examinations, in any subject, may be excused from the final examination in that subject, at the discretion of the instructor in charge, and with the approval of the Dean. When a final examination is taken, the year's rating in the subject is based half on the examination and half on the record of the year's work.

Students will not be admitted to professional work in the several courses without satisfactory records in those previous subjects on which this work especially depends. That is, for illustration, a student cannot take Advanced Surveying until he has completed Elementary Surveying.

Exceptions to this rule may be made in individual cases, after special consideration by the instructor in charge and the Dean.

Reports of Standing

Informal reports in all subjects are sent every two months, and formal reports covering the year's work are sent at the close of each year. These reports are sent to students, and to the parents, or guardians, of the students. Notification will be made to parents, or guardians, in all cases of students advised or required to withdraw, or placed on probation.

Conduct

It is assumed that students come to the School for a serious

purpose, and that they will cheerfully conform to such regulations as may from time to time be made. In case of injury to any building, or to any of the furniture, apparatus, or other property of the school, the damage will be charged to the student, or students, known to be immediately concerned; but, if the persons who caused the damage are unknown, the cost of repairing the same may be assessed equally upon all the students of the School.

Students are expected to behave with decorum, to obey the regulations of the School, and to pay due respect to its officers. Conduct inconsistent with the general good order of the School, or persistent neglect of work, if repeated after admonition, may be followed by dismissal, or, in case the offense be a less serious one, the student may be placed upon probation. The student so placed upon probation may be dismissed if guilty of any further offense.

It is the aim so to administer the discipline of the School as to maintain a high standard of integrity and a scrupulous regard for truth. The attempt of any student to present, as his own, any work which he has not performed, or to pass any examination by improper means, is regarded as a most serious offense, and renders the offender liable to immediate expulsion. The aiding and abetting of a student in any dishonesty is also held to be a grave breach of discipline.

REQUIREMENTS FOR GRADUATION

To be graduated by the School, the student must have satisfactorily completed all subjects of his chosen course and in addition to this, he must have completed his period of practical work to the satisfaction of his employer.

No student will be graduated until all dues to the School are discharged. The diplomas awarded graduates will be signed by both the school authorities and the employers.

Students completing the school course without being engaged in any practical work, will receive a special diploma.

Fees

The tuition fee until September 1, 1913, is $100 per year, and must be paid as follows:

One dollar with application for admission.

Nine dollars at the time of registration.
Twenty dollars before receiving any supplies.
Thirty dollars December 1.
Thirty dollars February 1.
Ten dollars April 1.

This fee includes membership in the Association, as well as the use of all books, drawing supplies, etc., which are required in the school work. Such supplies as are required by the student for his school work, are loaned to him by the School, and must be returned on demand, in good condition, or else paid for.

Increase of Tuition

The tuition of all students entering the school, on and after September 1, 1913, will be $110 per year.

This tuition fee of $110 must be paid as follows:

One dollar with application for admission.
Nine dollars additional at time of registration.
Twenty dollars before receiving any supplies.
Thirty dollars December 1.
Thirty dollars February 1.
Twenty dollars April 1.

Those students who are already members of the School at that time will be allowed to complete their course at the same rate of tuition that existed at the time of their entrance.

Payments

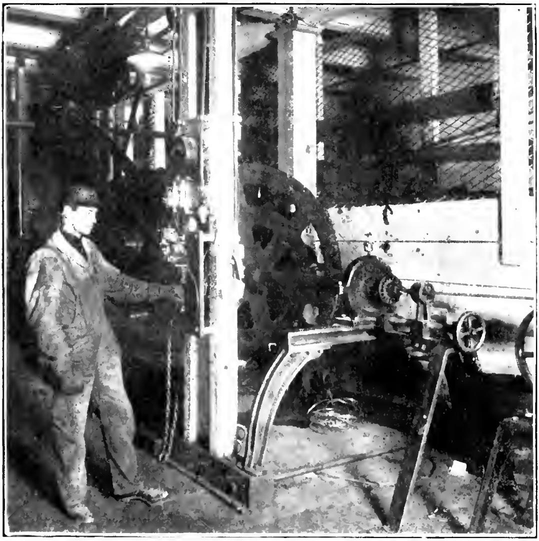
All payments should be made to Galen D. Light, Bursar.

Residence

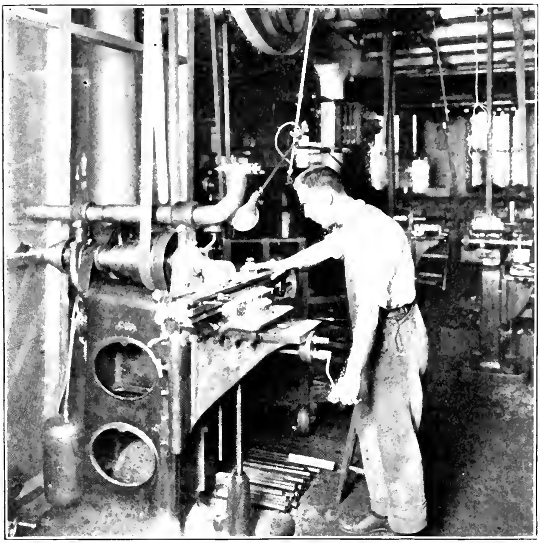
For those students who will not be living at home, there will be excellent accommodations, at very moderate rates, in the dormitories that are being constructed in our new building. These rooms may be had separately, or in groups with a common reception room, and the price will vary from $1.50 or $2.00 upwards. As board costs from $3.50 to $5.00 a week, a student could get room and board for from $5.00 a week to $6.00 per week.

Location

The buildings are located on Huntington Avenue, just beyond Massachusetts Avenue, and are within easy access to



OPERATING A CABLE MACHINE
Cable Room
Simplex Wire and Cable Company



MILLING INSULATOR ENDS
Machine Shop
Boston Elevated Railway Company

the various railroad stations, and the business and residential sections, by electric cars.

Special Students

It is possible for students to enter the School and spend either every week at school, or else every other week at school, without being placed in practical employment. There is no extra charge under these conditions.

A student obtaining a low rating on his entrance examinations, or who may not be eligible to assignment to practical work, for other reasons, may, by special permission, be allowed to attend school either every week or every alternate week, and, if his record for the year justifies it, may be assigned to practical work the following year.

It has been found possible for students to attend school every week and to complete the course in three years. To do this, the student must have had a good high school education and cannot do the practical work in connection with the course.

Socials

In order to provide for the social intercourse of the students, as well as to enable the men in the different divisions to meet one another, socials and entertainments are held monthly for their exclusive enjoyment. An out-door field meet is also held yearly, in May, at which time various inter-class competitive games are enjoyed.

Vacations

The employers allow our students one week vacation at Christmas, and two weeks vacation during the summer. They are not paid for this time.

Summer Employment

When a student, for good reason, is unable to continue his practical work during the summer, when the school is not in session, it is sometimes possible to get him leave of absence for the summer so that he can return to his employer in the fall. All special arrangements for the summer work must be referred to the Dean.

POST-GRADUATE OPPORTUNITIES

Students of good ability, on completing the Co-Operative Engineering Course, have the opportunity to attend the Massachu-

setts Institute of Technology if they care to, and by taking special extra work in the Co-Operative School during their course they could reasonably expect to complete the Technology work and get their degree in two years. Through conference with officials of the Institute, it has been found that those of our courses equivalent to theirs will probably be accepted in place of theirs, and the student given a clear record in such subject, either by passing an examination, or at the discretion of the head of the Department. Since a large number of our courses are covering the same ground as those at the Institute, a capable student should be able at the end of his course to get a clear rating at Technology for at least the equivalent of two years' work there. This offers a rare opportunity for an ambitious capable young man to get the most valuable kind of an education at small cost.

Requirements for Admission

In general, the preparation necessary to enable an applicant to pursue successfully one of the regular courses, corresponds with that afforded by high schools of the better grade, offering a four-year course of study.

Every applicant must furnish references as to his character and ability, and must show cause why he may reasonably be expected to make a success of his course, both in the practical work and at the School. He must be willing and able to work hard, both mentally and physically.

For those unable to carry on the Engineering Work owing to inadequate preliminary training, it has been found possible to plan special courses, of one or two years' duration, in the Preparatory School to fit for the Engineering Courses.

All applicants planning to take the examinations, shall notify the Dean not less than ten days previous to the date of the examinations. For those students who may not be prepared to take the examinations in June, but who desire to work during the summer and then take the examinations in the Fall, arrangements may be made by consultation with the Dean.

Any subjects not passed in the June examinations may be passed at the September examinations.

Applicants for admission to the Co-Operative Engineering School are, in general, required to pass the entrance examinations of the School. Certificates of entrance examinations passed for admission to another similar school of the same, or higher grade, may be accepted in lieu of examinations.

A student obtaining an average of 80%, or over, during his high school course, in the subjects required for admission, may be given credit in those subjects, without examination, upon application to the Dean. Such applications, together with a certificate from his principal, or instructor, stating the work done and the grades received, shall be filed with the Dean, not less than ten days preceding the examination date.

ADMISSION TO THE FIRST YEAR

The student intending to enter the School should bear in mind that the broader his intellectual training in any direction, and the more extensive his general acquirements, the greater will be the advantages he may expect to gain. The importance of thorough preparation in the subjects set for examination also is great; for the character and the amount of instruction given in the School from the outset, leave little opportunity for one, imperfectly fitted, to make up deficiencies, and render it impossible for him to derive the full benefit from his course, or perhaps even to maintain his standing. The training given in the best high schools will, in general, afford suitable preparation.

The requirements of age and scholarship specified are regarded as a minimum in all ordinary cases, and only exceptional circumstances will justify any relaxation. Parents and guardians are advised that it is generally for the ultimate advantage of the student not to enter under the age of eighteen years.

ENTRANCE EXAMINATIONS IN BOSTON

Examinations for admission to the first year class will be held at 288 St. Botolph Street on June 26 and 27 and on September 10th and 11th, 1913.

Students are advised to attend the June Examinations if possible, in order that any deficiencies then existing may be made up in September, before entrance.

Fees

Before taking the examination the applicant must have registered for admission to the School by the payment of ten dollars, as stated under "Registration" on a previous page. If he passes the examination, the fee will be credited toward his tuition; if he fails to pass, one-half the fee will be returned, the balance being retained to defray the expenses of making out the examination and correcting the papers.

Order of Examinations

Thursday, June 26, 1913

9.45 A.M. to 10.00 A.M.	Registration of Applicants
10.00 A.M. to 12.00 N.	Algebra
1.00 P.M. to 3 P.M.	Plane Geometry

Friday, June 27, 1913

10.00 A.M to 12.00 N.	English
1.00 P.M. to 3.00 P.M.	Physics

SUBJECTS FOR EXAMINATION

To be admitted as a student of the first-year class, the applicant must have attained the age of seventeen years, and must have passed satisfactory examinations in the following subjects:—

Elementary Algebra
Plane Geometry
English
Elementary Physics

The examination in Physics is not required, but students not receiving a clear record in it, by examination or otherwise, will be required to take a special course in Physics, in addition to their regular first year work.

The detailed requirements in the various subjects are as follows:—

Plane Geometry

The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

Algebra

The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one, or more, unknown quantities; problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative.

English

The examination in English will be as far as possible a test of the candidate's ability to express himself in writing in a manner at once clear and accurate.

The candidate will be required to write upon subjects familiar to him. His composition should be correct in spelling, punctuation, grammar, idiom and formation of paragraphs,

and should be plain and natural in style. He will be judged by how well, rather than by how much he writes.

Physics

The candidate will be expected to be familiar with the fundamental principles of Physics. It is especially desirable that he should have a good knowledge of general mechanics and of the mechanics of solids, liquids and gases. A knowledge of physical hypotheses is comparatively unimportant. Text-book instruction should be supplemented by lecture-room experiments. A sufficiently extended treatment of the subject will be found in any of the principal textbooks now in use in secondary schools. Ability to solve simple problems will be expected.

Certificates

A student obtaining an average of 80%, or over, during his high school course, in the subjects required for admission, may be given credit in those subjects, without examination, upon application to the Dean. Such applications, together with a certificate from his principal, or instructor, stating the work done and the ranks received, shall be filed with the Dean, not less than ten days preceding the examination date.

Conditions

A candidate failing in only one or two of the examination subjects, may be admitted with "conditions." A candidate incurring conditions in June must repeat, in September, examinations in those subjects in which he has failed.

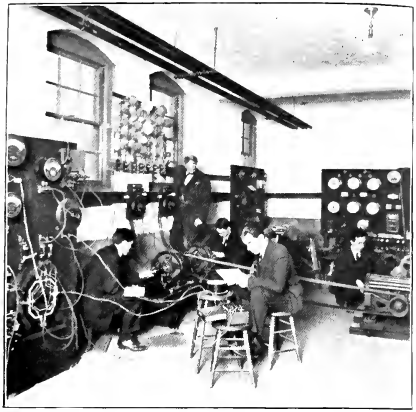
In any case of a condition existing after a second examination in a subject, special arrangements must be made with the Dean, before a student will be allowed to attend classes.

Courses of Study

General Information

The schedules of the various courses are given on the following pages. The first year work of all courses is practically the same, with a few exceptions, which are made because of the need of the student for elementary training in his professional subjects. This is done so that he may gain more from his early practical work, as well as be of more use to his employer, by reason of a better understanding of the duties he may be called upon to do.

The school year comprises eighteen weeks of class work, and one week of examinations for each division, so by dividing the total hours of class work by eighteen, the number of hours per week in any subject may be readily determined. For example, if mathematics comes ninety hours per year, it will be given five hours per week. Some subjects are given double time, but only extend through half the year. The student is expected to spend from one to two hours in preparation, for every hour given over to class work, in all subjects except Drawing.



CLASS IN DYNAMO TESTING
Determining the Characteristics of a Direct Current Shunt Generator

IN THE RESEARCH LABORATORY
A. D. Little Co., Inc., Engineering Chemists
Hydrolyzing Wood Fiber into Alcohol

CLASS IN SURVEYING FIELD WORK
Making a Stadia Survey of Jamaica Pond

COURSES OF STUDY

Mechanical Engineering

First Year

	Hours of Exercise per year
Mathematics I	90
Descriptive Geometry I	90
Lettering	18
English I	54
Physics I, Lectures, Laboratory and Recitations	108
Mechanical Drawing	144
Practical Electricity I, optional	72

Second Year

	Hours of Exercise per year
Physics II, Lectures, Laboratory and Recitations	90
Wood and Pattern Work, optional	54
Descriptive Geometry II	36
Mathematics II	36
Chemistry E I, Lectures	36
English II	36
Mechanical Engineering Drawing	162
Mechanism	72
Valve Gears	18
Applied Mechanics I	54
Practical Electricity I	72
Foundry Practice	18

Third Year

	Hours of Exercise per year
Applied Mechanics II	72
Machine Drawing	144
Metallurgy of Iron	18
Chemistry E II	36
Heat Engineering: Thermodynamics and Boilers	90
Mechanical Engineering Drawing and Boiler Drawing	72
Practical Electricity II	72
Metal Working, optional	54
Forging, Chipping and Filing, optional	36
Materials	36
Foundations	18
Hydraulics	54

Fourth Year

	Hours of Exercise per year
Applied Mechanics III	36
Applied Mechanics Laboratory	12
Dynamics of Machines	36
Practical Electricity III	72
Engineering Laboratory	36
Machine Design	144
Hydraulic Motors	36
Power Plant Design	54
Concrete Construction	36
Thesis	108

COURSES OF STUDY
Electrical Engineering
First Year

	Hours of Exercise per year
Mathematics I	90
Descriptive Geometry I	90
Lettering	18
English I	54
Physics I, Lectures, Laboratory and Recitations	108
Mechanical Drawing	144
Practical Electricity, optional	72

Second Year

	Hours of Exercise per year
Physics II, Lectures, Laboratory and Recitations	108
Mechanism	72
Wood and Pattern Work, optional	54
Chemistry E I	36
Mechanical Engineering Drawing	90
Mathematics II	36
Descriptive Geometry II	36
English II	36
Valve Gears	18
Applied Mechanics I	54
Elementary Electricity	54
Direct Current Practice	54
Methods of Wiring and National Electrical Code	9
Elementary Electrical Laboratory	36

Third Year

	Hours of Exercise per year
Applied Mechanics II	72
Heat Engineering: Thermodynamics and Boilers	90
Machine Drawing	90
Alternating Currents	45
Alternating Current Machinery	45
Alternating Current Laboratory	72
Electrical Engineering Laboratory	72
Technical Electrical Measurements	18
Construction, Operation and Maintenance of Local Intercommunicating Telephones, optional	6
Forging, Chipping and Filing, optional	36
Hydraulics	54
Chemistry E II	36

Fourth Year

	Hours of Exercise per year
Studies in Electrical Construction	36
Illumination and Photometry, optional	9
Central Stations	18
Electric Railways	36
Electrical Engineering Laboratory and Reports	54
Electric Light and Transmission of Power	9
Metallurgy of Iron	18
Hydraulic Motors	36
Machine Work, optional	72
Surveying	36
Applied Mechanics III	36
Applied Mechanics Laboratory	12
Engineering Laboratory	36
Thesis	108

COURSES OF STUDY

Civil Engineering

First Year

	Hours of Exercise per year
Mathematics I	90
Descriptive Geometry I	90
Lettering	18
English I	54
Physics I, Lectures, Laboratory and Recitations	108
Mechanical Drawing	72
Surveying I	144

Second Year

	Hours of Exercise per year
Advanced Surveying and Plotting	144
Mathematics II	36
Physics II, Lectures, Laboratory and Recitations	108
Mechanism	72
Descriptive Geometry II	36
English II	54
Topographical Drawing	36
Applied Mechanics I	54
Chemistry E I	36

Third Year

	Hours of Exercises per year
Railroad Engineering, Fieldwork and Drawing	126
Railroad Engineering	54
Dynamical and Structural Geology	72
Practical Electricity I	72
Applied Mechanics II	72
Materials	36
Metallurgy of Iron	18
Hydraulics	54
Foundations	18
Lithology	18
Stereotomy	36
Chemistry E II	36

Fourth Year

	Hours of Exercise per year
Theory of Structures: Bridges and similar structures	144
Structural Design	108
Heat Engineering: Thermodynamics and Boilers	90
Practical Electricity II	72
Concrete Construction	36
Applied Mechanics III	24
Applied Mechanics Laboratory	12
Hydraulic Motors	36
Hydraulic and Sanitary Engineering	36
Highway Engineering	36
Thesis	108

COURSES OF STUDY

Chemical Engineering

First Year

	Hours of Exercise per year
Mathematics I	90
Descriptive Geometry I	90
Chemistry I, Lectures, Laboratory and Recitations	144
Lettering	18
English I	54
Physics I, Lectures, Laboratory and Recitations	108
Mechanical Drawing	72
German I	54

Second Year

	Hours of Exercise per year
Qualitative and Quantitative Analysis	216
Mechanism	72
Mathematics II	36
Physics, II Recitations, Lectures and Laboratory	108
Descriptive Geometry II	36
Practical Electricity I	72
English II	54
Valve Gears	18
Mechanical Engineering Drawing	72
Applied Mechanics I	54
German II	54

Third Year

	Hours of Exercise per year
Quantitative Analysis	126
Machine Drawing and Boiler Drawing	90
Applied Mechanics II	72
Heat Engineering: Thermodynamics and Boilers	90
Technical Analysis	108
Metallurgy of Iron	18
Technical Electrical Measurements	18
Electrical Engineering Laboratory	72

Fourth Year

	Hours of Exercise per year
Organic Chemistry	90
Organic Chemical Laboratory	144
Chemical Engineering Problems	18
Industrial Chemistry	54
Industrial Chemical Laboratory	90
Shop Work, optional	72
Hydraulics	54
Engineering Laboratory	36
Applied Mechanics Laboratory	12
Thesis	108

Subjects of Instruction

Instruction is given by lectures and recitations, and by practical exercises in the field, the laboratories, and the drawing-rooms. These exercises form the foundation of each of the four Courses. Text-books are used in many subjects, but not in all. In some branches the instruction given differs widely from available text-books; and, in such cases, either notes are issued by the instructor, or else the student is required to take very complete notes in the lectures.

Besides oral examinations in connection with the ordinary exercises, written examinations are held from time to time. General examinations are held in May and June.

In the following pages will be found a more or less detailed statement of the scope as well as the method of instruction of every subject offered in the various Departments The subjects are classified according to the Departments in which they are given, related studies being arranged in sequence.

SYNOPSIS OF COURSES

Mathematics I

Variation, logarithms, slide rule, exponential equations, the uses of formulas in Physics and Engineering.

Trigonometry, including circular measure, co-ordinates, trigonometric ratios, formulas, law of sines, law of cosines, solution of right and oblique triangles, applications to problems in Physics and Engineering, Elements of Spherical Trigonometry.

Mathematics II

Co-ordinates, plotting of functions, interpolation, the straight line, curves represented by various equations, graphic solution of equations, determination of laws from the data of experiments.

Rate of increase, differentiation, determination of maxima and minima by differentiation, integration, definite integrals, determination of mean value, area and volume by integration, centre of gravity, moment of inertia, partial differentiation.

English I

This is a course in the principles of composition and letter writing. Special attention is given to spelling, punctuation and grammar.

The chief object of the work is to enable the student to write correct, lucid and easy business English.

English II

This course is a continuation of English I and is devoted to writing business letters, to descriptions of processes and machinery, and to all other possible means of enabling the student to express himself with accuracy and precision, both orally and in writing.

Mechanical Drawing

The course extends through the first year. The instruction in Mechanical Drawing relates to the drawing instruments and materials, instrumental constructions and the drawing of irregular curves, tracing in ink, conventions, lettering, dimensioning and working methods. The work includes several drawings of machine details.

Descriptive Geometry I

The course covers the simpler problems on the point, line and plane and various constructions in the projection of solids, including sections and developments.

In the latter half of the course, the problems on the line and plane are completed, and the projection of solids is continued through the intersection of solids bounded by plane faces. Isometric drawings and several practical applications are given.

Descriptive Geometry II

The course is a continuation of Descriptive Geometry I, and deals with single and double curved surfaces; their intersection by oblique planes, tangent planes, penetrations, development and so forth.

Lettering

The work consists of letter drawing and stroke lettering for working drawings. The instruction is given by short lectures on the principles and processes of freehand drawing, and individual criticism. The latter part of the work is devoted to further work in letter drawing and stroke rendering, the construction of titles and title designing.

Physics I

The subjects considered are general mechanics, molecular mechanics, wave-motion, electricity and optics, which topics are discussed both mathematically and experimentally. It is the purpose of the course to lay a thorough foundation for subsequent study of experimental, and technical physics. Hence it is planned with immediate reference to familiarizing the pupil with the fundamental principles of the science. The lectures are illustrated by suitable experiments.

Physics II

A course of experimental lectures which is a continuation of Physics I. In this work the student completes the study of physics started with Physics I.

German I

This course consists of three exercises a week and is intended to give the student a good ground work in German as it is written and spoken.

German II

This course consists of three exercises a week covering more difficult reading, both literary and scientific, than is taken in German I. On the completion of the course, students should be able to read understandingly any ordinary newspaper, or magazine article of a literary, or popular scientific nature, to understand simple spoken German and to express simple thoughts in German.

Surveying I

This course consists of a series of lectures, supplemented by exercises in the field and the drawing-room. The student is taught the use of the chain, tape, compass, solar compass and transit, and the use of various forms of levelling instruments. The work in the drawing-room consists in making the computations which arise in the work of the surveyor, in making scale drawings, profiles and contour maps from notes taken in the field, and in studying the application of contour maps to the solution of problems of drainage, road location, landscape engineering, etc. The text-book used is the Principles and Practice of Surveying by Professors Breed and Hosmer, Vol. I.

Surveying II

This course consists of lectures and work in the field and the drawing-room. The instruction includes the use of the stadia and plane table in topographic surveys, of the sextant in hydrographic and astronomical work, of the barometer for determining differences of elevation, of the slide rule for computations, the construction of stadia diagrams, and the making of topographic maps. The text-book used is the Principles and Practice of Surveying by Professors Breed and Hosmer, Vols. I and II.

Topographical Drawing

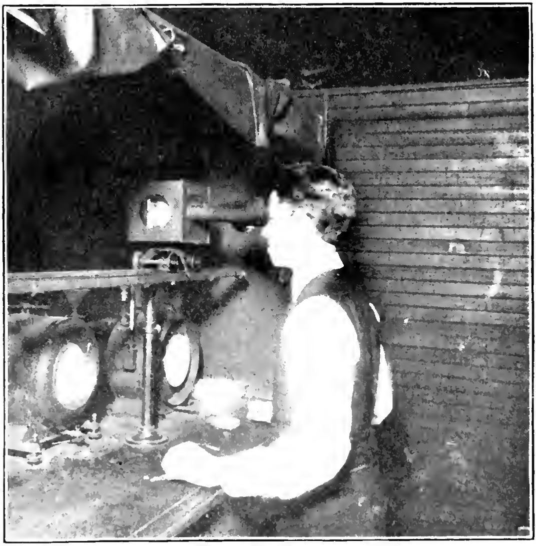
This course consists of two hours per week in the drawing-room devoted to the study of the different conventional signs employed in making topographical maps. Each student is required to make a number of plates, and to become reasonably proficient in the preparation of such maps. Particular attention is given to the study of contour maps, and the solution of problems relating thereto.

Highway Engineering

This course comprises an outline of the principles governing the location, construction and maintenance of roads, and the construction and maintenance of the various kinds of pavements for city streets.

Railroad Engineering

This course consists of a thorough study of curves and earthwork and their application in location and construction. It treats of simple curves; functions, degree of curve, relations between the primary functions, use of tables for curves, deflection angles, deflection distances, offsets from tangents field methods, ordinates. Simple curve problems: substituting curves ending in parallel tangent, miscellaneous problems, obstacles on tangent and curve. Compound curves: problems, changing P. C. C. to end in parallel tangent, substitution of compound for simple curves. Reversed curves: connecting parallel tangents, connecting non-parallel tangents. Parabolic curves: horizontal, vertical curves. Turnouts, parts of turnouts, stub switch, split switch methods, connections of parallel tracks, yard computations, staking out turnouts. Turnout tables. Y tracks and crossing frogs: computation and layout of Y tracks, cross-



DETERMINING THE CANDLE POWER OF GAS
Everett Works
Boston Consolidated Gas Co.

MAKING A HIGH POTENTIAL TEST ON A CONCENTRIC FEEDER
Chatham Street Substation
Edison Electric Illuminating Company

ing frogs for straight and curved tracks. Easement curves: cubic spiral, Searle's spiral, methods of offsets and of reflection angles. Application to compound and reverse curbes. Earthwork: slope stakes, cross-sections, different forms of sections. Methods of computing earthwork; averaging end areas, prismoidal formula, prismoidal correction and other methods. Correction for curvature, burrow pits. Earthwork tables and diagrams: their construction and uses. Also haul and mass diagram.

Railroad Fieldwork and Drawing

This course is devoted to the survey and plotting of a railroad. A reconnoissance is first made, and this is followed by a preliminary survey with transit and level and the taking of contours as a basis for fixing the position of the location survey which is next carried out. All this work follows modern practice in laying out railroads. There is also a systematic drill in running in curves of various kinds, including transition curves, and in staking out earthwork. From the notes made in the field, a map and a profile of the preliminary survey for a railroad are plotted and finished. A further problem consists of a careful study in adjusting a line of railroad location upon a contour map, involving computation of the earthwork, and the preparation of a "mass diagram" for the determination of "haul" and of "borrow and waste."

Hydraulic and Sanitary Engineering

This course treats of the drainage of lands together with a course in irrigation, in which are studied the constructions and methods employed in this and other countries, including the arrangement and proportioning of diversion weirs, canals, distributaries, falls, regulators and other special works and modes of applying water to the soil. The subject of water supply is taken up, and embraces the study of the quantity of water required for city and town supplies, estimation of the yield from drainage basins, stream flow and ground water flow, computations to determine the necessary storage to insure a given supply, the proportioning of standpipes, conduits and distribution systems, conditions affecting the quality of water, and sedimentation and filtration works for improving the quality. The subject of water power is also studied with attention

to the considerations governing the location and development of water-power plants modes of estimating the power capacity of given water privileges. The text-books used are Turneaure and Russell's Public Water Supplies, Swan and Horton's Hydraulic Diagrams and Wilson's Irrigation Engineering.

Hydraulic Motors

A series of exercises, mainly recitations, based upon a text-book, so as to embrace the laws of flow in open channels and of the dynamic pressure and work of water flowing over curved surfaces. The time is principally given however, to a study of impulse wheels and reaction turbines, with reference to their proper construction, regulation and testing and to the various sources of loss of energy in their operation.

Theory of Structures

This course is devoted to class and drawing-room work in studying the loads, reactions, shears and moments acting upon structures of various kinds, as roofs and bridges. It treats of the computation and design of structures of wood, steel and masonry, by analytical and by graphical methods. The subjects considered are: the plate girder, roof and bridge trusses of various forms, trestles of wood or steel, earth pressure, retaining walls, masonry dams, arches of metal, stone or concrete. The object is to train the student thoroughly in the application of the principles of Mechanics to the design of structures. The text-book used is Spofford's Theory of Structures.

Foundations

The subjects treated in this course are as follows: Building stones and concrete, bearing power of different kinds of soil, examination of the site, designing the footings, whether of masonry or of steel and concrete, independent piers, pile foundations, compressed air processes, freezing processes, retaining walls, together with some details of buildings for industrial purposes, constructed of steel or of reinforced concrete. Baker's Masonry Construction is used as a text-book.

Materials

This course takes up a consideration of the properties of the various materials used by the engineer, such as stone, brick, cement, concrete, wood, iron and steel.

Structural Design

A course in which the students are instructed in the design

of structures of wood, stone and metal. Each student is given a set of data, and is required to perform all the computations and to make designs and working drawings for several structures such as a masonry dam, a plate girder bridge and a wooden roof truss. His work is criticized as it progresses.

Concrete Construction

A course consisting of lectures and drafting, in which instruction is given in the theoretical and practical principles involved in the design of structures of plain and reinforced concrete. The course includes a study of the simple reinforced concrete beam, the design of slabs, I-beams, columns, footings, retaining walls and arches. Instruction is given by means of lectures and text-books, in conjunction with which each student is given practical problems in design to be worked out in the drawing room.

Applied Mechanics I

The course comprises a study of statics, consisting of the general methods and applications of statics, including the determination of the reactions, stresses in frames; of distributed forces, center of gravity; of moment of inertia, radius of gyration of plane areas and solids, including principal axes and principal moments of inertia; of kinematics and dynamics including the equations for uniform and varying rectilinear and curvilinear motion, centrifugal force, unresisted projectile, pendulum, harmonic motion, rotation, combined rotation and translation, momentum and angular momentum, center of percussion, impact, work, power and kinetic energy.

Applied Mechanics II

The course comprises a study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to tension, to compression and to shearing; common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moments, slopes and deflections.

A study is also made of the theory of elasticity, including the determination of the resultant strains in any direction.

Applied Mechanics III

The course treats of the laws of friction, including a study of the distribution of friction on shaft journals and pivots; also

a study of the transmission of power by belting and by ropes, and of the friction reducing power of lubricating oils. A study is also made of the continuous girder, so planned as to apply to beams, and applications of the principles of Mechanics and of the Strength of Materials to the design of other forms of simple structures.

Applied Mechanics Laboratory

The tests made by the students in the Applied Mechanics Laboratory include tests to determine the modulus of elasticity, limit of elasticity, yield point and tensile strength of steel bars; tests of the deflection and of the transverse strength of a wooden beam subjected to a transverse load; tests to determine the modulus of elasticity and tensile strength of wire; tests on cement mortars, including practice in laboratory methods.

Foundry Practice

A lecture course dealing with coring, ramming, venting, facing, spruing, use of risers, etc., as used in flask moulding. Various forms of molding machines, as power squeezer, hinged, and turn over are studied. Foundry appliances for pouring are discussed.

Wood-Working and Pattern Work

This is a course designed to give students facility in the common operations of carpentering and cabinet work, together with the use and care of wood working machinery, as lathes, saws, planers, etc.

The course includes instruction in Wood-turning having special application to Pattern-work, an illustrated discussion of the principles of moulding to explain clearly and show reasons for "Draft" on patterns and methods of allowing it, instruction in the use and making of core-boxes and methods of building up patterns.

Metal Working

This course is to train students in the common operations of metal working, as chipping and filing, forging and machine work, as that done on lathes, drill presses, shapers and milling machines.

Mechanism and Valve-Gears

This course includes a systematic study, not only of the motions and forms of the various mechanisms occurring in

machines, and the manner of supporting and guiding the parts, independently of their strength, but also of the design of gear-teeth. The course also includes the theory and practice of designing valve-gears for steam-engines, including the plain slide valve, link motions, radial valve-gears, double valves and drop cut-off valves.

Mechanical Engineering Drawing

The instruction includes the drawing of simple machine details, such as bolts and nuts, screws, springs, keys, flanges, pipe fittings, etc.; teaching systems of dimensioning, conventional representations, and blue-printing. The latter part of the work consists of drawing, illustrating the class-room work in connection with the courses in Mechanism and Valve-gears including the design of cams, gear-teeth, slide-valves, double valves, the Stephenson link, etc.

Machine Drawing

The aim of the course is to teach the proper way of making the necessary dimensioned drawings for use in practice, good shop systems being adopted. The instruction includes the making of working detail and assembly drawings of machinery from measurements.

Heat Engineering: Thermodynamics and Boilers

It includes a study of the principles of thermodynamics; a discussion of the properties of gases, saturated and superheated vapors, especially of air and steam; of the flow of fluids through orifices, nozzles, pipes and meters, a discussion of the action of the steam injector; a study of the various cycles of the hot air, internal combustion and steam engines, of the turbine, air compressor and refrigerator systems. These engineering applications are treated from the physical, analytical and graphical points of view, so as to give the student a good foundation in the principles of thermodynamics, in the solution of actual heat engineering problems. The course also includes a study of the simple, compound and multiple expansion steam engine, of the different types of gas engines, of the gas producer, of compressed air and refrigerator machines, and the methods of testing such machines.

The latter part of the course includes a study of the various types of steam boilers and the different kinds of power plant

apparatus, including fans, blowers, economizers, condensers, feed pumps, etc. A short discussion of the construction and stability of chimneys is also given.

Engineering Laboratory

This course consists of exercises and tests upon the various forms of appliances in use in a power plant, such as

Boiler Test
Steam Engine Testing
Steam Turbine Testing
Fans and Blowers
Pumps—Centrifugal and Duplex
Condensers
Feed Water Heaters
Flue Gas Analysis

Power Plant Design

The course consists largely of drawing-room work and calculations, with such lectures as may be needed from time to time. The work of the course consists in making the working drawings necessary to show the location of boilers, engines, auxiliaries, piping, coal pockets, etc., for a power house and also drawings and calculations of some of the details.

Dynamics of Machines

The course in Dynamics of Machines includes a number of the principal applications of Dynamics to moving machinery such as governors, fly-wheels, the action of the reciprocating parts of the steam-engine, running balance, whirling speed of shafts, etc. The work is supplemented by a course in drafting.

Machine Design

The main object of the course is the application of principles already learned to the solution of problems in design. Each student makes a number of complete designs, such as a boiler, a large shaft with pulleys and gears, a set of couplings, a power shear, geared pump, etc. For each design the constructive details are carefully discussed; each student then makes all the necessary calculations to determine the dimensions of every part, and finally he completes the working drawings. The scope of the designs is such as to include most of the elementary principles of design, and yet is sufficiently limited to enable the student to complete every detail, as it is believed that only by such thorough work can real benefit be obtained.

Chemistry E I

This is an experimental lecture course covering chemical practice as applied to engineering work. It treats of the gases used in the arts, as hydrogen, oxygen, acetylene, etc.; their preparation, properties and uses, as well as the oxyhydrogen blow pipe, oxy-acetylene blast, etc. Paints, concrete, alloys, corrosion and its preventatives, are also dealt with. In addition to this, the work takes up oils, fuels, fuel gases, explosives, glass, mineral insulators, the commonly used acids and bases, etc. The consideration is taken up from the engineer's standpoint, rather than the chemist's.

Chemistry E II

This is a continuation of Chemistry E I in which the consideration of the various subjects is concluded.

Chemistry I

The fundamental principles of the science are taught in connection with the descriptive chemistry of the non-metallic elements. The lectures are designed to precede the work of the laboratory, in which the students are expected to verify and illustrate the principles and facts which have been discussed in the lecture room. Careful manipulation, thoroughness in observation, accuracy in arriving at conclusions, and neatness in note-taking, are required of each student. The course lays the necessary foundation for subsequent chemical study.

Chemistry II. Qualitative Analysis

A practical course in qualitative analysis for the separation and identification of the common metallic elements and the acids. Each student is also required to make a complete and accurate analysis of various mixtures, alloys and chemicals used in manufacturing. The laboratory work is supplemented by a course of lectures and conferences, devoted to a general study of the properties of the common metals and their compounds.

Chemistry III. Quantitative Analysis

A course in gravimetric and volumetric analysis. Special attention is given to accurate manipulation, the preparation of standard solutions, the calibration of instruments and to the principles of stochiometry. The laboratory work is supplemented by a course of lectures and conferences.

Chemistry IV. Organic

A course consisting of lectures and conferences on the principles of organic chemistry as illustrated by the methane and benzene derivatives.

The student is required to prepare in the laboratory a number of organic compounds, selected to show characteristic organic reactions and to give training in the practical separation and purification of organic substances. After this synthetic work the students are given a practical course in organic analysis.

Industrial Chemistry

This course consists of a series of lectures and recitations upon the more important technical chemical processes, including those of Metallurgy. Much attention is given to the general operations common to many industries, such as crushing, grinding, lixiviation, filtration, evaporation, distillation, crystallization, etc., and to the details of various types of apparatus used for carrying on these processes. Some of the more important manufacturing industries, such as the production of alkali, fertilizers, glass, pigments, cement, soap, explosives, paper, as well as wood distillation, the refining of petroleum etc., are also considered in detail.

Metallurgy of Iron

A series of lectures taking up a general consideration of the Metallurgy of Iron and Steel. The introductory part is devoted to a discussion of the physical and chemical properties, and the constitution of cast iron, wrought iron and steel. This is followed by a more extended treatment of the production of cast iron, wrought iron, Bessemer, open-hearth cement and crucible steel, and of foundry work. In the discussion of the different processes, principles of manufacture are made prominent.

Technical Analysis

A course consisting mainly of laboratory practice in typical methods of water analysis and gas analysis and, so far as the time permits, the study of procedures applicable to the proximate technical analysis of industrial products.

Elementary Electricity

A course of experimental lectures, taking up a consideration

of static and voltaic electricity, batteries, electrolysis, magnetism and the study of electrical phenomena as far as electro-magnetic induction.

Elementary Electrical Laboratory

A course of exercises correlated with the work covered in Elementary Electricity, illustrative of the fundamental principles followed in the measurements of currents, resistances, potentials, capacities and inductances.

Studies in Electrical Construction

This course, which is correlated to that of Central Stations, consists of a series of excursions to Power Stations, Manufacturing Plants, etc., with drawing up of reports upon what is observed, and discussions of the same.

Practical Electricity I

This course is taken by the students in other than the Electrical Engineering Course. The work is planned so as to give the students taking it the elements of Electrical Engineering, together with experiments in Elementary Electrical laboratory. This introductory work is followed by a consideration of alternating currents and alternating current machinery, accompanied by selected experiments in the Electrical Engineering Laboratory. The student also is instructed in the principles of wiring, together with the rules of the National Electrical Code. The latter part of the work is devoted to Photometry, Electric Lighting and the Transmission of Power.

Practical Electricity II

A continuation of the work outlined in Practical Electricity I.

Practical Electricity III

The completion of the work outlined in Practical Electricity I.

Elements of Direct Current Practice

This course of lectures, recitations and problem work is devoted to the fundamental principles of Electrical Engineering. It includes a discussion of the laws and properties of electric and magnetic circuits, followed by an introduction to the study of variable currents and a treatment of the principles of direct

current machinery. The solution of problems illustrating the engineering principles involved forms an important part of the instruction. A part of the course is devoted to the theory and principles involved in the testing of direct current dynamos.

Alternating Currents

This course concerns itself with the general theory of alternating current circuits, and the application of the principles to various engineering problems. In connection with the work, considerable importance is attached to the solution of problems selected with reference to their engineering application.

Alternating Current Machinery

This course of lectures, recitations and problems is devoted to a careful discussion of the various types of alternating current machinery for the generation, transmission and distribution of power. The special properties of each machine are considered for the machine as a unit, and when it is used as a part of any electrical system; some of the general considerations concerning long-distance power transmission are also included.

Alternating Current Laboratory

The work includes such tests as efficiency, heating, regulation and determination of characteristics for alternating current machinery. The work in the laboratory is supplemented by conferences.

Electrical Engineering Laboratory

A course devoted to the study of direct-current machinery. The tests include the determination of characteristics, efficiency, regulation and heating, and are supplemented by laboratory conferences.

Technical Electrical Measurements

This course is designed to familiarize the student with the most important instruments and methods of electrical measurements.

Intercommunicating Telephones

A course of lectures in the construction, operation and maintenance of factory intercommunicating telephone sets.

National Electrical Code and Wiring

A discussion of the various approved methods of wiring. together with the specifications of the National Electrical Code.

Illumination and Photometry

A course of lectures and laboratory exercises dealing with the engineering problems in the production, measurement and utilization of artificial illumination.

Central Stations

This course consists of lectures and assigned readings treating of the design, construction and operation of electric power generating stations, including problems of management and questions of cost.

Electric Railways

A course of lectures including a discussion of the construction, equipment and operation of different types of electric roads, together with related problems in power transmission and generation.

Electric Light and Transmission of Power

A course considering the various problems of electric lighting and the electric transmission of power. The work consists of lectures and quizzes.

Lithology

This course is a laboratory study of the rock-forming minerals and the more common rocks.

Dynamical and Structural Geology

This course treats of earth movements and the various terrestrial applications of solar energy. The more important geological processes, erosion, sedimentation, deformation and eruption are taken up and discussed.

The latter part of the course is devoted to lectures on the broader structural features of the earth's crust and the application of the principles of structural geology to practical engineering problems.

Thesis

During the fourth year of his course the student is required to prepare a thesis on some subject included in his course of study; or an account of some research made by him; or an original report upon some machine, work of engineering, industrial plant, or an original design accompanied by an explanatory memoir.

Equipment

Note.—At the time of going to press, the buildings to contain these various departments are in process of erection to be completed in the spring of 1913.

DEPARTMENT OF PHYSICAL TRAINING

Our new gymnasium with all the latest modern equipment will give ample accommodation for all students.

There will be a running track on the grounds adjoining, together with tennis and hand ball courts; also a large natatorium where swimming will be taught by competent instructors.

MECHANICAL DEPARTMENT

Mechanical Laboratories

There will be a completely equipped steam engineering laboratory in the new building where students may make practical boiler and fuel tests, as well as study steam engineering practice. In addition to a complete modern power plant used for lighting and heating the buildings, there will be several engines used wholly for instruction purposes. The students also have the use of the equipment of our Automobile School, thus giving opportunity to study the most advanced ideas in gasoline engine practice.

MECHANIC ARTS LABORATORIES

There will be two large laboratories, one for metal work and the other for wood work. These will be for the use of those students whose practical work does not include courses of this character. The metal working laboratory is now in use in connection with the Automobile School and includes: one large and one small drill press, one large and one small engine lathe, a high-speed lathe, emery wheel, shaper, grinding machine, electric drill and milling machine, together with the necessary equipment for complete machine, and bench work instruction.

The wood working laboratory will include planers, saws, steam boxes and benches, together with all necessary equipment for complete instruction in practical woodworking.

LIBRARIES

There is in connection with the School a professional library containing books pertaining to both the school work of the boys and to their practical work. In addition to this there also are current periodicals on engineering and scientific subjects for their exclusive use. All members of the School are entitled to take books from the Boston Public Library, and this offers a very unusual opportunity to our non-resident students.

DEPARTMENT OF CHEMISTRY

The Chemical Laboratories will have accommodations for more than one hundred and fifty students. The Department will comprise three laboratories, a lecture room, a reference room, a combustion room, a balance room, office and supply room. These laboratories will be equipped with the most modern apparatus for all lines of chemical work. For analytical work, there will be every facility for rapid and accurate work. In addition to this there will be all necessary apparatus for fuel and gas analysis, as well as for a complete course in organic chemistry. The equipment of the laboratories will include vacuum and pressure apparatus, balances, electrolytic circuits, combustion furnaces, gas absorption and explosion apparatus, sampling apparatus and flue thermometers and gas calorimeter. There will be also testing machines for oils, viscosimeters, and different sorts of flash point apparatus. A chemical museum will be connected with this department where will be kept specimens for purposes of illustration.

PHYSICS DEPARTMENT

There will be a large laboratory devoted entirely to Physics, together with a lecture room.

The laboratory will be equipped with the most improved devices for instruction in general physical measurements, including the mechanics of solids, liquids and gases, light and heat.

ELECTRICAL DEPARTMENT

The laboratory is well equipped with apparatus and possesses a set of instruments for teaching the principles of measurement including; slide-wire and Carey-Foster Bridges, Laboratory Bridge, Portable Testing Set, Potentiometer, apparatus for testing insulation, together with a large assortment of minor

apparatus which can be combined in many ways for the exigencies of any particular test which may be desired for some special instruction.

The equipment of instruments for practical measurement is very complete, consisting of a large number of Weston D. C. ammeters and voltmeters of various types, ranging in size from 1 to 100 amperes and from 3 to 750 volts, while for alternating current work there are six Weston portable ammeters and eight Westinghouse switchboard ammeters, all fitted with current transformers for 6600 volt circuits with 50 and 25 ampere primaries and 5 ampere secondaries.

Also 4 Weston portable voltmeters and six Westinghouse switchboard voltmeters with 150 volt scales and all supplied with potential transformers of 10 and 20 to 1 ratio. Two G. E. switchboard type recording three phase wattmeters, and one Westinghouse round pattern one, three single phase induction type watt hour meters, several General Electric iron clad indicating wattmeters and a pair of high torque General Electric Test meters.

There is also a large and complete equipment of auxiliary apparatus, as synchronizers, power factor indicators, frequency indicators, speed counters, tachometers, Proney brakes, and the many minor pieces of apparatus needed in practical testing and operating of machinery.

Among the machines of this Department are a pair of specially made, matched machines, arranged to run either as single-phase, two-phase or three-phase generators or motors, as well as synchronous transformers, double current generators or, on the D. C. side as shunt, series or compound generators or motors, and also as three wire generators on the Dobrovolsky plan.

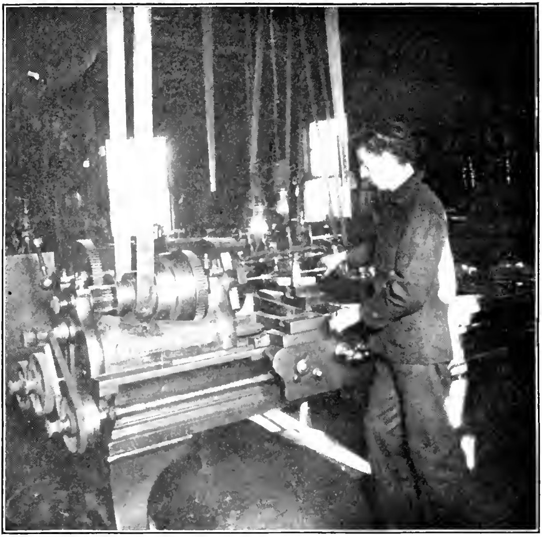
A 60-Horse power 60 cycle single phase 500 volt alternator, a smaller (7½-Horse power) special G. E. 60 cycle 250 volt alternator revolving field, tapped for either 1, 2, 3, 6 or 12 phase currents and supplied with special *rotors* changing it into a synchronous, or induction motor of three types, as well as into a frequency changer, a Thomson-Houston Inclined coil, compound generator.

There have recently been added three good sized constant

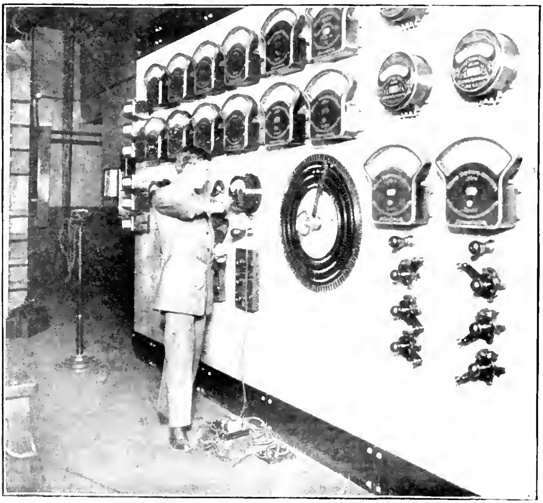
Potential and three Constant Current Transformers. Also a $2\frac{1}{2}$-horsepower General Electric Induction motor for 60 cycles and 220 volts.

In addition to the foregoing equipment we have been informed by the officials of the Massachusetts Institute of Technology that it could very probably be arranged for us to make use of their unexcelled laboratories and apparatus when we needed them, at times when they were not in use by their own classes, thus enabling our students to avail themselves of the finest experimental equipment in the country.

At the time of going to press our evening school classes are using the Chemical Laboratories of the Institute, and it ought not to be a far step to a similar arrangement for our day work.



MACHINE WORK
Air Brake Shop
Boston and Maine Railroad



CHECKING VOLTMETERS
Head Place Station
Edison Electric Illuminating Company

Courses in Day Schools

Alternating Current
Alternating Current Laboratory
Alternating Current Machinery
Algebra I
Algebra II
Applied Mechanics I
Applied Mechanics II
Applied Mechanics III
Applied Mechanics, Laboratory
Arithmetic
Arithmetic, Commercial
Automobile Garage Course
Automobile Machine Shop Course
Automobile, Operator's Laboratory Course
Automobile, Operator's Lecture Course
Automobile, Operator's Road Course
Bookkeeping, Advanced
Bookkeeping, Elementary
Calculus
Central Stations
Chemistry I
Chemistry II
Chemistry I, Engineering
Chemistry II, Engineering
Concrete Construction
Design, Machine
Design, Power Plant
Design, Structural
Drawing, Boiler
Drawing, Freehand
Drawing, Machine
Drawing, Mechanical
Drawing, Topographical
Dynamics of Machines
Elementary Electrical Laboratory
Electrical Engineering Laboratory
Elementary Science
Electric Railways
Electricity I
Electricity II
Electricity III
Electric Light and Transmission of Power
English I
English II
English III
English IV
English, Business
Forging, Chipping and Filing
Foundations
Foundry Practice
French I
French II
French III
French IV
Geology, Dynamical
Geology, Structural
Geometry, Plane
Geometry, Solid
Geometry, Analytical
Geometry, Descriptive
German I
German II
German III
German IV
Greek
High Temperature Measurements
Highway Engineering
Heat Engineering: Thermodynamics and Boilers
History, American
History, Ancient
Hydraulics, Theoretical
Hydraulic Motors
Hydraulic and Sanitary Engineering
Illumination and Photometry
Industrial Chemistry
Industrial Design
Intercommunicating Telephones
Latin I
Latin II
Latin III
Latin IV
Law, Commercial
Lettering
Lithology
Materials
Mathematics I, Engineering
Mathematics II, Engineering
Machine Design
Metal Work
Metallurgy of Iron
Penmanship
Physics I
Physics II
Physics, Laboratory
Public Speaking
Qualitative Analysis
Quantitative Analysis
Railroad Engineering
Shorthand I
Shorthand II
Spanish
Spelling
Stereotomy
Studies in Electrical Construction
Surveying
Surveying, Advanced
Trigonometry
Typewriting
Theory of Structures
Technical Electrical Measurements
Valve Gears
Wiring and National Code
Wood Working and Pattern Work

Courses in Evening Schools

Accounting Problems, Advanced
Agency
Algebra I
Algebra II
Architectural Drawing I
Architectural Drawing II
Arithmetic
Arithmetic, Commercial
Auditing, Advanced
Auditing, Elements of
Automobile, Operator's Road Course
Automobile, Operator's Lecture Course
Automobile, Operator's Laboratory
Automobile Garage Course
Automobile Machine Shop Repair Course
Bankruptcy
Bills & Notes
Bookkeeping, Elementary
Bookkeeping, Advanced
Business Organization & Administration
Calculus
Chemistry I
Chemistry II
Chemistry III
Chemistry IV
Civil Service
Concrete I
Concrete II
Constitutional Law
Contracts
Corporations
Cost Accounting, Elements of
Cost Accounting, Advanced
Court Practice
Criminal Law
Drawing, Freehand
Drawing, Mechanical
Economics, Applied
Economics, Principles of
Elementary Science
Electricity I
Electricity II
Electricity III
English I
English II
English III
English IV
English, Business
Equity I
Equity II
Evidence
Firing
French I
French II
French III
French IV
Geometry, Plane
Geometry, Solid
Geometry, Analytical
German I
German II
German III
German IV
Greek
History, American
History, Ancient
Illustrating & Cartooning
Industrial Design
Italian
Latin I
Latin II
Latin III
Latin IV
Law, Commercial
Law, Special (in Law School)
Lettering
Machine Drawing
Massachusetts Practice
Mathematics, Engineering
Mathematics, Practical
Mechanism
Partnership
Penmanship
Physical Geography
Physics
Physiology
Plan Reading & Estimating
Pleading
Property I
Property II
Property III
Public Speaking
Railroad Engineering
Sales
Shorthand I
Shorthand II
Spanish
Spelling
Steam Engineering
Surveying, Plane
System Building, Advanced
System Building, Elements of
Torts
Trigonometry
Typewriting
Window Dressing

Preparatory School Subjects scheduled both Winter and Summer Terms

General Departments

DEPARTMENT OF PHYSICAL WORK

ALBERT E. GARLAND, M.D., B. P. E. Director

The Physical Department is under the best supervision and the aim is to better fit men for their life work by increasing their efficiency through exercise. We offer: Well equipped gymnasiums, Recreative, Hygienic and Educational Gymnastics. Numerous classes the year round. Shower, steam and electric baths. Best instruction. Medical direction. Hand ball courts.

DEPARTMENT OF RELIGIOUS WORK

EDWIN W. PEIRCE, Director

In order that a young man may secure a well-balanced development and attain a spiritual foundation for successful life work, the Association advises each member in planning his schedule to enter into one or more of the following activities:—

Bible Study, Sunday Meetings of Men, Personal Service Groups and The Twenty-Four-Hour-A-Day Club.

DEPARTMENT OF SOCIAL WORK

DAVID M. CLAGHORN, Director

The attention of members is called to the many opportunities in the Association for social service, and the following social features.

A Newly Equipped Game Room.	The Popular Novel Club.
The Association Congress.	The Land and Water Club.

Popular Social Evenings.

DEPARTMENT OF EMPLOYMENT

FREDERICK W. ROBINSON, Director

The Employment Department is in actual practice, a clearing house for young men seeking work, and employers who wish to engage reliable help. From 5000 to 8000 men apply every year. Members of the Association are given 25 per cent discount from the legal rates and special effort is made to notify them when good positions are open.

BOYS' DEPARTMENT

DON S. GATES, A.B., City Secretary

The physical, social, employment and religious advantages offered to boys from twelve to eighteen years, are similar to those offered to men as stated above. Membership dues for the boys range from one to six dollars according to the privileges desired.

C.S.

THE CO-OPERATIVE ENGINEERING SCHOOL

CATALOG

1914-1915

PUBLISHED BY THE
EDUCATIONAL DEPARTMENT
OF THE
BOSTON YOUNG MEN'S CHRISTIAN ASSOCIATION
316 HUNTINGTON AVENUE
BOSTON, MASS.

CATALOG

OF THE

CO-OPERATIVE ENGINEERING SCHOOL

BOSTON

1914-1915

CATALOG

OF THE

INSTRUCTING STAFF

TOGETHER WITH

A Statement of the Requirements for Admission

AND

A Description of the Courses of Instruction

OUR NEW HOME

This is a picture of the new Association Building which was finished in the Fall of 1913. It contains, among other features, school accommodations of the very best, a fine gymnasium, bowling alleys, swimming pool, café, dormitories, shops and laboratories, library and reading room, camera club rooms, social and recreative rooms, and auditorium.

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YEARLY CALENDAR

1914

JANUARY

S	M	T	W	T	F	S
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FEBRUARY

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1915

JANUARY

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SEPTEMBER

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DECEMBER

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CALENDAR

1914

February 23, Monday
Washington's Birthday Celebration (School exercises omitted)
April 20, Monday
Patriots' Day Celebration (School exercises omitted)
May 30, Saturday
Decoration Day (School exercises omitted)
June 1–13, inclusive
Final examinations
June 16, Tuesday
Graduation
June 17–September 12, inclusive
Summer vacation
June 11 and 12, Thursday and Friday
Entrance Examinations of Co-Operative Engineering School
July
Practical work commences for First Division
September 9–10, Wednesday and Thursday
Second Entrance Examinations for Co-Operative Engineering School
September 14, Monday
First Term of the year 1914–1915 commences
September
Practical work for Second Division commences
October 12, Monday
Columbus Day (School exercises omitted)
November 26, Thursday
Thanksgiving Day (School exercises omitted)
December 21–26, inclusive
Christmas Recess (School exercises omitted)

1915

January 18, Monday
Second Term begins
February 22, Monday
Washington's Birthday (School exercises omitted)
April 19, Monday
Patriots' Day (School exercises omitted)
May 31
Decoration Day Celebration (School exercises omitted)
June 1–12, inclusive
Final Examinations
June 10–11, Thursday and Friday
Entrance Examinations of Co-Operative Engineering School
June 11, Friday
Graduation
June 14–September 11
Summer Vacation
July
Practical work for First Division commences
September 8–9, Wednesday and Thursday
Second Entrance Examinations for Co-Operative Engineering School
September 13, Monday
First Term of the school year 1915–1916 commences
September
Practical work for Second Division commences
October 12, Tuesday
Columbus Day (School exercises omitted)
November 25, Thursday
Thanksgiving Day (School exercises omitted)
December 20–25 inclusive
Christmas Recess (School exercises omitted)

OFFICERS OF ADMINISTRATION

General Administrative Officers

ARTHUR S. JOHNSON, *President*
JACOB P. BATES, *Vice-President*
HAROLD PEABODY, *Recording Secretary*
FRANCIS B. SEARS, *Treasurer*
GEORGE W. MEHAFFEY, *General Secretary*

Educational Committee

JOHN ROUSMANIERE, *Chairman*
WILLIAM E. MURDOCK
ALBERT H. CURTIS
MORGAN L. COOLEY
GEORGE H. MARTIN

Educational Administrative Officers

FRANK P. SPEARE, *Director of Education*
GALEN D. LIGHT, *Asst. Director of Educ. and Bursar*
H. W. GEROMANOS, *Supt. of Evening School System*
IRA A. FLINNER, *Supt. of Day School System*
CHARLES B. GRAY, *Secretary*
ERNEST H. BROOKE, *Registrar*

ADVISERS

The following gentlemen are acting in an advisory capacity on the more important executive matters of the school where their service is of the greatest value to us:

Dr. Richard Maclaurin, President of Massachusetts Institute of Technology.
Charles A. Prosser, Secretary of National Commission on Industrial Education.
James P. Munroe, Secretary of Massachusetts Institute of Technology Corporation.
William McKay, General Manager, New England Gas & Coke Co.
Paul Winsor, Chief Engineer, Boston Elevated Railway Company.

OFFICERS OF INSTRUCTION

H. W. GEROMANOS, S.B., Mass. Inst. Tech.
DEAN

CARL S. ELL, S.B., M.S., Mass. Inst. Tech.
ASSISTANT DEAN

J. A. COOLIDGE, S.B.
Mathematics and Physics

LOREN N. DOWNS, Jr., S.B.
Electrical Engineering

D. V. DRISCOLL
Chemistry

CARL S. ELL, S.B., M.S.
Civil Engineering

A. L. GARDNER, S.B.
Mechanical Engineering

H. W. GEROMANOS, S.B.
Chemistry and Metallurgy

W. E. RICHARDSON, S.B.
Surveying and Railroad Engineering

FREDERICK C. HOSMER, A.B.
English

JOHN W. HOWARD, S.B.
Surveying

ERVIN KENISON, S.B.
Descriptive Geometry

MYLES S. MAXIM
Mechanism

THOMAS E. PENARD, S.B.
Mathematics

M. E. PINKHAM
Mathematics

CHARLES H. RESTALL, B.S.
Railroad Engineering

C. H. SAMPSON, S.B.
Mechanical Drawing

W. LINCOLN SMITH, S.B.
Electrical Engineering

ELLWOOD B. SPEAR, A.B., Ph.D.
Chemistry

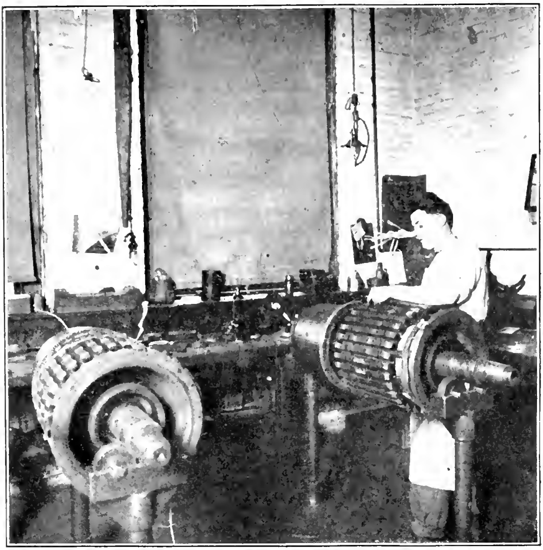
SAMUEL A. S. STRAHAN
Chemistry

D. M. TAYLOR, S.B.
Valve Gears

HAROLD I. WILLIAMS, B.S.
Mechanical Drawing

At the time of going to press, our annual election of instructors for the year has not been held, and so it is impossible to publish a complete list of the faculty for 1914–1915.

TAKING LEVELS FOR A CROSS SECTION
Weymouth Landing
Aspinwall and Lincoln, Civil Engineers



INSERTING COILS IN 150 HORSE-POWER ARMATURE
Armature Shop
Boston Elevated Railway Company

GENERAL INFORMATION

It has generally been conceded that, where the practical and the theoretical elements of education can be taught simultaneously, the greatest good is derived by the student, and efforts are being made in all departments of education to accomplish this greatly desired end.

Technical school instruction, depending on class room work and laboratories, must always lack some of the vital characteristics of an actual manufacturing plant, owing to the fact that one is for educational purposes, while the other is operated for dividends. It is this latter fact that gives the Co-Operative School idea one great advantage over our usual educational plan. Instead of protecting the student, and training him for several years, for a line of work to which he may later find himself to be entirely unfitted, the Co-Operative School at once puts the boy to work in a commercial plant. There he learns life in its vital issues, as well as the problem of getting along with men; thus early finding out whether he has made a wise, or unwise, choice of his life work. This training, too, shows him the use and value of his school work, and finally gives him an unusual apportunity to acquire from actual experience that rare thing, *executive ability*, without which his life probably will always be spent on the lower levels of industry.

That the young men of New England might have an opportunity to attend such a technical school, where both practice and theory are correlated, and at the same time be enabled to defray a large part of the expense of their education by the returns from their practical work, the Co-Operative Engineering School of the Boston Young Men's Christian Association was started in 1909.

This school has now been in operation for five years, and the continually increasing interest in it, as well as its rapid and steady growth, show that it was much needed to fill a place that is filled by no other school in this vicinity.

OBJECT OF THE SCHOOL

The fundamental aim of this school is to train, for positions in Engineering work, young men who are unable to attend the highest grade technical schools, or colleges. Thus they are enabled to advance farther, and more rapidly, in their chosen work than they could reasonably expect to do without further education than that of a high school course. The training is not in any sense that of a trade school, nor is it exactly that of our best scientific schools, but it stands between the two. The work done is that of a regular technical school, of high standards, but only the essential subjects are taken, and they, only so far as they will have a direct bearing on the life work of the student. In other words, it is a limited technical training of high grade. The fact that most of our instructors are graduates of, or instructors in, the Massachusetts Institute of Technology, will show the character of work being done.

At present there are four lines of Engineering work being given, and the end sought is to give to students who have already had a high school preparation, or its equivalent, a good training in the fundamental sciences of Mathematics, Chemistry, and Physics, and in the important applications of the principles of these sciences to the several branches of engineering. More stress is laid on the development of the ability to apply the acquired knowledge to new engineering problems, than to the memorizing of a multitude of details and very abstract theory, which, while valuable, cannot be gone into too deeply in a course of this type.

The class room instruction is given to small sections, and in the drawing rooms and laboratories, the students receive a great deal of personal attention. The independent solution of assigned problems forms a large part of nearly all courses.

The courses differ from those of many schools, in that a student is not permitted a wide range of subjects from which to choose, in the belief that better results are obtained by prescribing, after the student has selected the line of work for which he desires to prepare himself, the principal studies which he is to pursue.

PLAN OF OPERATION OF THE SCHOOL

To illustrate the idea of the curriculum at the school, take for instance, the case of a young man "A" who desires to take our Mechanical Engineering course.

"A" is assigned to one of the plants of a firm that is co-operating with us. Here he is put to work and spends that week working in the shop. The next week, "B" his mate, who has spent the first week in the school, takes "A's" place in the shop, and "A" puts in the week at school. Thus the work goes on, the two men exchanging places at the beginning of each week. The studies pursued in the course have a direct practical bearing on the outside work, with the exception of a few courses added, because of the aim which we have, to produce a better citizen, as well as a better employee. The courses given have been decided upon after conference between the co-operating employers and the school authorities, and are the result of the best ideas of both. The subjects are taught in a practical, not in an abstract, or a theoretical way. Thus, in mathematics, instead of teaching algebra, analytic geometry and calculus, as so many separate subjects, they are correlated and taught as instruments for the solution of practical problems arising in engineering work. The aim throughout the course is to give it practical bearing and yet have it complete and thorough in all the needed essentials.

At the time of going to press, the School is working on an alternation interval of two weeks. This plan has been found to be more satisfactory than the one-week period, by a similar school, and, if it proves to be better for our students, we will retain it. Otherwise we will revert to the one-week period heretofore in vogue.

Correlation of Practical and Theoretical Work

The outside work of the student is as carefully planned as that at the school, and it is progressive. The employers who co-operate with us generally agree, where practicable, to employ the boys in all the different departments of their establishments during their periods of practical duties; this training is just as complete as the school work, and is just as thorough. Where possible, the course of the learner is from the handling

of the raw material to the shipment of the finished product. This practical training includes the use of the machines, as well as the executive duties of the plant, so that at the end of his course the graduate may not only know how to do things, but also why they are done in certain ways, and he may, we hope, be of value in improving methods of work.

Co-Operating Firms:

The following firms are co-operating with us at the present time and giving employment to our students:—

Boston Elevated Railway Co.
Boston & Albany Railroad Co.
    Mechanical Engineering Department
    Civil Engineering Department
Boston & Maine Railroad Co.
    Mechanical Engineering Department
    Civil Engineering Department
Boston Consolidated Gas Co.
Aspinwall and Lincoln, Civil Engineers
New York, New Haven & Hartford Railroad Co.
Bay State Street Railway Co.
    Civil Engineering Department
    Mechanical Engineering Department
Edison Electric Illuminating Co.
A. D. Little Co., Inc.
    Engineering Chemists
H. F. Bryant, Civil Engineer
Simplex Electric Heating Co.
Simplex Wire and Cable Co.
Frank E. Sherry, Civil Engineer
Gray & Davis, Inc.
    Electrical Devices for Automobiles

Several other firms have agreed to co-operate with us, but the demand for our boys, this year, was such that we were unable to fill all the positions offered.

Thus far, we have secured new positions for our students as the growth of the School has demanded. However, to be at all sure of work in his chosen branch of engineering, an applicant should file his application early, as the number of positions in any one line is necessarily limited.

SCHEDULES OF PRACTICAL WORK

Below are typical schedules of practical work that have been prepared for our students by some of the companies which are giving our boys employment:—

BOSTON ELEVATED RAILWAY CO.

First Year

Six months, pit work in carhouse.
Six months, armature room.

Second Year

Twelve months, machine shop work.

Third Year

Six months, mechanical drafting room.
Six months, power station work.

Fourth Year

Six months, line department.
Six months, electrical engineer's department.

BOSTON & MAINE RAILROAD COMPANY

Six months, air brake shops.
One year, erecting work.
One year, machine shop.
One year, engine house repairs.
Six months, drafting room and testing work.

BOSTON CONSOLIDATED GAS CO.

Nine months, data takers.
Three months, office.
Three months, pipe fitter's helpers.
Three months, pump man's helpers.
Three months, blowers and exhausters.
Three months, laboratory.
Three months, boiler room.
Three months, generator house.
Three months, steam fitters.
Three months, machine shop.
Three months, assistant engineers.
Six months, laboratory.
Three months, distribution department.

SIMPLEX WIRE AND CABLE CO.

Six months, Insulating Department.
Six months, Braiding Department.
Six months, Cable Shop.
Six months, Twisting Department.
Six months, Machine Shop Construction Gang.
Six months, Electrical Construction Gang.
One year, Testing Room.

SIMPLEX ELECTRIC HEATING COMPANY

Machine Department	1 year	
Grinding Department	1 month	
Stock Department	4 months	
Winding Department	$\frac{1}{2}$ month	$\frac{1}{2}$ year
Enamelling Department	$\frac{1}{2}$ month	
Assembling Department	$\frac{1}{2}$ year	
Testing Department, First Division	$\frac{1}{2}$ year	
Testing Department, Second Division	$\frac{1}{2}$ year	
Shipping Department, approximately	2 mos.	$\frac{1}{2}$ year
Drafting Department, approximately	4 mos.	
General shop experience	$\frac{1}{2}$ year	

The above programmes show what the boys do in their practical work, and the courses of study pursued at the school show what they do along academic lines. It will be seen that there is a considerable degree of correlation between theory and practice in the work they take up. The men under whose supervision the boys have been in their outside work, are practically unanimous in approval of our plan, and speak highly of the enthusiasm, earnestness and intelligence the students have shown in the performance of their duties.

Attitude of Co-Operating Firms

Almost all the concerns which co-operated with us last year, took one, or more, additional pairs of our students this year, which in itself is significant of their attitude toward our plan.

Earnings

For the practical work the student does, he is paid a certain amount per hour at the start, and a definite increase per hour, after completing fixed periods of service. The sum earned is more than enough to pay the tuition and the necessary expenses of schooling, but will not cover the cost of living.

In some cases the boys are paid at a higher rate than is called for by their schedule of pay, but that is a courtesy of the company that gives them employment, and is not in any way to be expected as a regular thing. The co-operating firms may make any salary schedule they desire, so long as it does not fall below that originally agreed upon.

The companies which co-operate with us, agree to pay our students ten (10) cents per hour during their first year of service; twelve (12) cents per hour during the second year; four-

teen (14) cents per hour during the third year, and sixteen (16) cents per hour during the fourth year.

Basing the earnings on this scale, the student will earn from five (5) to six (6) dollars per working week during the first year, and an increase of approximately one (1) dollar per working week, for each succeeding year of the four. As there are about thirty weeks of work per year, the earnings will be from one hundred and fifty dollars, upwards.

Frequently a student is able to earn much more than the regular rate, owing to getting extra pay for overtime work.

A census of our students who were working in January, 1914, gave the following data in regard to earnings:

Minimum weekly wage	$5.00
Maximum weekly wage	12.65
Minimum earnings for January, 1914	9.60
Maximum earnings for January, 1914	31.65
*Minimum earnings for year 1913	150.00
*Maximum earnings for year 1913	375.00

Expenses

As the earnings of the students average from $150 to $300 a year, while expense for tuition, books, drafting supplies, etc., and membership in the Y. M. C. A. is not over $110, there is a considerable balance for incidentals.

While the School supplies all books, drawing instruments, slide rules, note books, etc., it has been found impracticable to furnish the students with paper, drawing ink and pencils, during the year. In consequence of this, the student will have a slight expense, of less than a dollar, for paper and pencils, after he uses those supplied at the beginning of the year.

Relation of the Co-Operative School to High Schools

This School is peculiarly adapted to the high school graduate who, although financially unable to continue his studies further, still has the ambition and ability to get ahead if given the opportunity. Thus boys, being graduated from high school, can still live at home, but spend their time in fitting themselves for something better in the future.

*Based on a total working period of thirty weeks.

This year, the School has a student body made up of graduates of the following High Schools:

Amesbury High School
Beverly High School
Black River Academy
Boston English High School
Boston Latin School
Boston Mechanic Arts High School
Bromfield High School
Cape Elizabeth High School (Maine)
Charlemont High School
Chelsea High School
Chicopee High School
Concord High School
Cony High School (Augusta, Maine)
Everett High School
Foxboro High School
Framingham High School
Gardiner High School (Maine)
Gardner High School
Groton High School
Hamilton High School
Hardwick High School
High School of Commerce
Holliston High School
Hudson High School
Huntington Preparatory School
Hyde Park High School
Lynn English High School
Malden High School
Marblehead High School
Marlboro High School
Medford High School
Middleboro High School
Milford High School
Natick High School
Norwood High School
Peabody High School
Reading High School
Rindge Technical High School
Sanford High School (Maine)
Salem High School
Saugus High School
Somerville English High School
Swampscott High School
Tilton Seminary
Tisbury High School
Wakefield High School
Waltham High School
Wayland High School
Wellesley High School
Weston High School
West Roxbury High School
Weymouth High School
Wilmington High School

Number of Students

The number of positions at our disposal in any one branch of engineering is necessarily limited, and so the number of students who can work part-time in that line is also limited. In consequence of this, those students who apply first, will get first consideration in the matter of positions, and those who

wish to enter should present their applications as soon as possible.

Those applicants who apply for admission to the School too late to be assigned to practical work, may attend the School every week, or every alternate week, as they may wish, and will be assigned to practical work as soon as an opening occurs.

Outside Interests

A moderate participation in social and athletic activities is encouraged by the Faculty, although a standard of scholarship is required of the students which is incompatible with excessive devotion to such pursuits.

Four-Year Courses

Regular four-year courses leading to a diploma, are offered in the following branches of engineering:—

I. Civil Engineering
II. Mechanical Engineering
III. Electrical Engineering
IV. Chemical Engineering

Descriptions of these courses and schedules showing the subjects of instruction included, will be found on succeeding pages.

Summer Schools

There are day and evening summer preparatory schools, conducted by the Educational Department of the Association, and students having entrance conditions, or requiring further preparation for the entrance examinations, may avail themselves of this opportunity to cover the desired work.

Those of our students, who fail to pass in any of their school work, may be permitted to take up the study in the Summer School conducted by the Institute of Technology, provided of course, that Institution is offering such a course. Those students desiring this privilege should consult the Dean, as special permission must be obtained to attend many of the courses.

Physical Training

Those students who desire gymnasium instruction may obtain the same by the payment of the gymnasium fee in ad-

dition to their tuition. This will entitle the student to exercise with the regular classes, as well as to use the gymnasium at other times.

Requirements for Admission

Detailed information in regard to the requirements for admission to the courses of instruction in the School, will be found on succeeding pages. In general, the preparation necessary to enable an applicant to pursue one of the Courses, corresponds with that given by good high schools in their four-years' course.

Application for Admission

An application blank will be found just inside the back cover of this catalog. Fill it out in ink and mail it, together with the required five (5) dollar deposit, to H. W. Geromanos, Dean, 316 Huntington Ave., Boston, Mass.

School Year

The term begins September 14, 1914, and on succeeding years the school year will commence on the second Monday in September. The school exercises are suspended on legal holidays and for one week at Christmas.

Registration

Each applicant for admission to the School is required to fill out an application blank, whereon he states his places of previous education, as well as the names of persons to whom reference may be made in regard to his character and previous training.

A deposit of five (5) dollars is required when the application is filed. Should the applicant be rejected, without being permitted to take the entrance examinations, one half this fee will be returned to him. Should the application be approved, the fee will be retained to cover the cost of his registration, examinations, etc. This fee is non-returnable.

On approval of the application, the applicant is required to fill out an attendance card, blank forms of which will be supplied. He is also required to fill out an application for membership in the Association. A twenty (20) dollar fee, which

is credited as part payment of his tuition, must be paid at this time.

This fee of twenty (20) dollars must be paid before a student will be assigned to a position at practical work, or allowed to attend classes.

Once the applicant has passed the entrance requirements and been accepted by the School, this fee is non-returnable.

An additional thirty (30) dollars is required to be paid before any books, or supplies, are issued to him.

Summing up the foregoing:

When a student applies for admission to the School, he makes a deposit of five dollars, which is not considered as part of the tuition, but is used to cover registration expenses. Of the hundred and ten (110) dollar tuition, twenty (20) dollars must be paid before an applicant will be assigned a position at practical work, and an additional thirty (30) dollars, or in all, fifty dollars must be paid before a student will have books and supplies issued to him.

Attendance

Students are expected to attend all exercises in the subjects they are studying, unless excused by the Dean. With the exception of one hour in the middle of the day, exercises are held, and students are, in general, expected to devote themselves to the work of the school between 9 A.M. and 5 P.M. There are no exercises on Saturday after 1 P.M.

Books and Supplies

The student is furnished with all books, drawing instruments, slide rules, and general supplies, required for his work. This material is loaned to him during the school year, and must be returned in good condition, on demand, or else paid for.

At the commencement of the year, pens, pencils, note books and note book paper, etc., are issued to each student, but none of these minor supplies will be issued again during the year. The cost for additional incidental supplies should not run much over one dollar per year.

Status of Students

The ability of students to continue their courses is determined in part by means of examinations; but regularity of attendance and faithfulness to daily duties are considered equally essential.

Any student failing to make a satisfactory record in either school, or practical work, may be removed from his position in practical work, or from the School.

Examinations

Examinations in all subjects are held at the close of each school year, in May and June, and cover the work done during the year. All students who maintain a year's average of 80% or over, in their daily work and informal examinations, in any subject, may be excused from the final examination in that subject, at the discretion of the instructor in charge, and with the approval of the Dean. When a final examination is taken, the year's rating in the subject is based half on the examination and half on the record of the year's work.

Students will not be admitted to professional work in the several courses without satisfactory records in those previous subjects on which this work especially depends. That is, for illustration, a student cannot take Advanced Surveying until he has completed Elementary Surveying.

Exceptions to this rule may be made in individual cases, after special consideration by the instructor in charge and the Dean.

Reports of Standing

Informal reports in all subjects are sent every two months, and formal reports covering the year's work are sent at the close of each year. These reports are sent to students, and to the parents, or guardians, of the students. Notification will be made to parents, or guardians, in all cases of students advised or required to withdraw, or placed on probation.

Owing to the short school year, it is of vital importance to the student that he get a clear record in all his work each week, and where a student fails to pass in any subject, a notification is sent to his parents, or guardian, to that effect, at the close

of the week in which the failure was recorded, so that we may have the home influence exerted to bring his work up to a higher rating the next week.

Conduct

It is assumed that students come to the School for a serious purpose, and that they will cheerfully conform to such regulations as may from time to time be made. In case of injury to any building, or to any of the furniture, apparatus, or other property of the school, the damage will be charged to the student, or students, known to be immediately concerned; but, if the persons who caused the damage are unknown, the cost of repairing the same may be assessed equally upon all the students of the School.

Students are expected to behave with decorum, to obey the regulations of the School, and to pay due respect to its officers. Conduct inconsistent with the general good order of the School, or persistent neglect of work, if repeated after admonition, may be followed by dismissal, or, in case the offense be a less serious one, the student may be placed upon probation. The student so placed upon probation may be dismissed if guilty of any further offense.

It is the aim so to administer the discipline of the School as to maintain a high standard of integrity and a scrupulous regard for truth. The attempt of any student to present, as his own, any work which he has not performed, or to pass any examination by inproper means, is regarded as a most serious offense, and renders the offender liable to immediate expulsion. The aiding and abetting of a student in any dishonesty is also held to be a grave breach of discipline.

REQUIREMENTS FOR GRADUATION

To receive the diploma of the School, the student must have attended the School not less than two years, which must be those immediately preceding his graduation, except as postponement may be specially permitted. He must have completed the prescribed studies of the four years, and must, also, pass final examinations, if required, on subjects pertaining especially to his Course. In addition to this, he must have

completed his period of practical work to the satisfaction of his employer.

The student must, also, prepare a thesis on some subject included in his course of study; or an account of some research made by him; or an original report upon some machine, work of engineering, or industrial plant. This thesis, or design, must be approved by the Dean. Theses are to be written on one side only of paper of good quality, 8 x $10\frac{1}{2}$ inches in size, with an inch margin on each side. Theses must be handed to the Dean not later than the day on which the first annual examination occurs.

All theses, and records of work done in preparation of theses, are the permanent property of the School.

The diploma of the School represents not only the formal completion of the subjects in the selected course of study, but also the attainment of a satisfactory standard of general efficiency. Any student, who does not show in the fourth-year work of his Course, that he has attained such a standard, may be required, before receiving the diploma, to take such additional work as shall test his ability to reach that standard.

No diploma can be given until all dues to the School are discharged.

The diplomas awarded graduates will be signed by both the School authorities and the employers.

Students completing the school course without being engaged in any practical work, will receive a special diploma.

Fees

A fee of five (5) dollars is to be paid when application is filed, as a matriculation fee. This fee is non-returnable, if the applicant is permitted to take the entrance examinations. If he is rejected, without taking the examinations, one half the deposit will be returned.

The tuition fee is $110 per year, and must be paid as follows:

Twenty dollars at the time of registration
Thirty dollars additional, before receiving any supplies
Thirty dollars December 1
Thirty dollars March 1

One half the year's tuition will be charged any student who attends the School during six school weeks.

The full tuition rate for the year will be charged any student attending the School over nine school weeks.

In case any student is compelled to discontinue attendance at the school, for any reason, after being assigned to practical work, there will be no rebate of any fees paid, under any conditions.

Upper class students whose tuition rate is $110 shall pay it as follows:

Forty dollars at beginning of fall term
Thirty dollars December 1
Thirty dollars February 1
Ten dollars April 1

Students who were enrolled in the School, when the tuition was increased from $100 to $110 per year, will be allowed to complete their course at the same rate of tuition that existed at the time of their entrance.

Such students shall pay their tuition as follows:

Thirty dollars before September 14
Thirty dollars December 1
Twenty dollars February 1
Twenty dollars April 1

Failure to make the required payments on time, renders the student liable to be barred from his classes, until the matter has been adjusted with the Bursar.

This tuition fee includes membership in the Association, as well as the use of all books, drawing supplies, etc., which are required in the school work. Such supplies as are required by the student for his school work, are loaned to him by the School, and must be returned on demand, in good condition, or else paid for.

Increase of Tuition

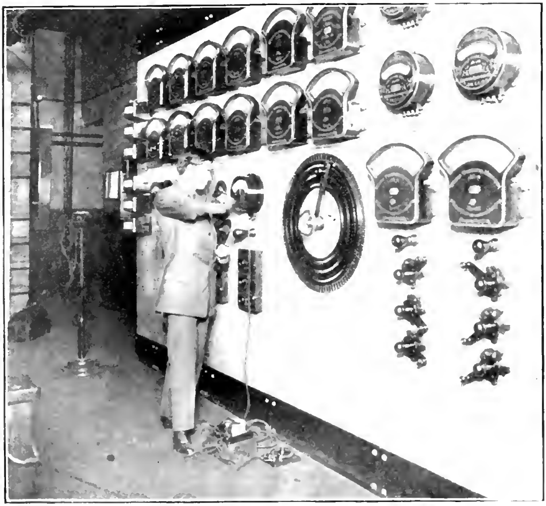
The tuition of all students entering the School, on and after January 1, 1916, will be $125 per year.

Those students, who are already members of the School at that time, will be allowed to complete their course at the same rate of tuition that existed at the time of their entrance.

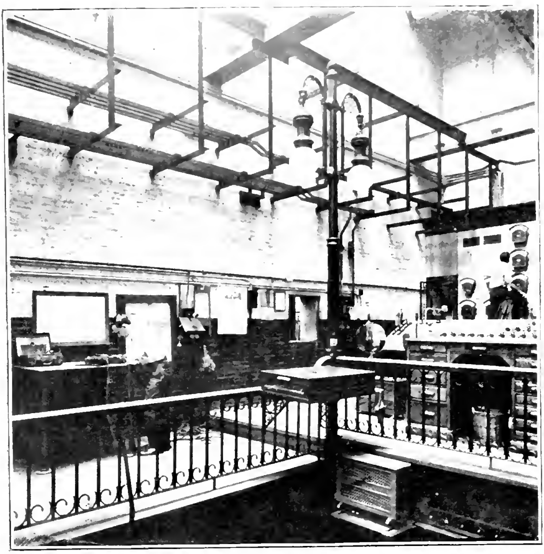
Payments

All payments should be made to Galen D. Light, Bursar.

Make checks payable to Boston Young Men's Christian Association.



CHECKING VOLTMETERS
Head Place Station
Edison Electric Illuminating Company



CHECKING BATTERY AMMETERS
Atlantic Avenue Station
Edison Electric Illuminating Company

Residence

For those students who will not be living at home, there are excellent accommodations, at very moderate rates, in the dormitories that are in our new building. These rooms may be had separately, or in groups with a common reception room, and the price varies from $1.50, or $2.00, upwards. As board costs from $3.50 to $5.00 a week, a student could get room and board for from $5.00 a week to $6.00 per week.

Location

The buildings are located on Huntington Avenue, just beyond Massachusetts Avenue, and are within easy access to the various railroad stations, and the business and residential sections, by electric cars.

Special Students

It is possible for students to enter the School and spend either every week at school, or else every other week at school, without being placed in practical employment. There is no extra charge under these conditions.

A student obtaining a low rating on his entrance examinations, or who may not be eligible to assignment to practical work, for other reasons, may, by special permission, be allowed to attend school either every week or every alternate week, and, if his record for the year justifies it, may be assigned to practical work the following year.

It has been found possible for students to attend school every week and to complete the course in three years. To do this, the student must have had a good high school education and cannot do the practical work in connection with the course.

Socials

In order to provide for the social intercourse of the students, as well as to enable the men in the different divisions to meet one another, socials and entertainments are held monthly for their exclusive enjoyment. An out-door field meet is also held yearly, at the close of the school year, at which time various interclass competitive games are enjoyed.

Vacations

The employers may allow our students one week vacation at Christmas, and two weeks vacation during the summer. They are not paid for this time. Whether a student shall have a full week at Christmas, or not, is at the option of the employer.

Summer Employment

When a student, for good reason, is unable to continue his practical work during the summer, when the school is not in session, it is sometimes possible to get him leave of absence for the summer so that he can return to his employer in the fall. All special arrangements for the summer work must be referred to the Dean.

Probation Period

When, for any reason, it is deemed advisable, the School reserves the right to place any entering student upon a period of probation, extending from one to three months, before placing him at practical work. Whether he shall be placed at work at the end of this time, will be determined by the character of the work that he accomplished during this probationary period.

POST-GRADUATE OPPORTUNITIES

Students of good ability, on completing the Co-Operative Engineering Course, have the opportunity to attend the Massachusetts Institute of Technology, if they care to, and by taking special extra work in the Co-Operative School during their course they could reasonably expect to complete the Technology work and get their degree in two years. Through conference with officials of the Institute, it has been found that those of our courses equivalent to theirs will probably be accepted in place of theirs, and the student given a clear record in such subject, either by passing an examination, or at the discretion of the head of the Department. Since a large number of our courses are covering the same ground as those at the Institute, a capable student should be able at the end of his course to get a clear rating at Technology for at least the

equivalent of two years' work there. This offers a rare opportunity for an ambitious capable young man to get the most valuable kind of an education at small cost.

For further information about the School, write to

H. W. Geromanos, Dean,
316 Huntington Avenue,
Boston, Mass.

REQUIREMENTS FOR ADMISSION

In general, the preparation necessary to enable an applicant to pursue successfully one of the regular courses, corresponds with that afforded by high schools of the better grade, offering a four-year course of study.

Every applicant must furnish references as to his character and ability, and must show cause why he may reasonably be expected to make a success of his course, both in the practical work and at the School. He must be willing and able to work hard, both mentally and physically.

For those unable to carry on the Engineering Courses owing to inadequate preliminary training, it has been found possible to plan special courses, of one, or two years' duration, in the Preparatory School to fit for the Engineering School.

All applicants planning to take the examinations, shall notify the Dean not less than ten days previous to the date of the examinations. For those students who may not be prepared to take the examinations in June, but who desire to work during the summer and then take the examinations in the Fall, arrangements may be made by consultation with the Dean.

Any subjects not passed in the June examinations may be passed at the September examinations.

Applicants for admission to the Co-Operative Engineering School are, in general, required to pass the entrance examinations of the School. Certificates of entrance examinations passed for admission to another similar school of the same, or higher grade, may be accepted in lieu of examinations.

A student obtaining an average of 80%, or over, during his high school course, in the subjects required for admission, may be given credit in those subjects, without examination, upon application to the Dean. Such applications, together with a certificate from his principal, or instructor, stating the work done and the grades received, shall be filed with the Dean, not less than ten days preceding the examination date.

The last page of this catalog is in the form of an application blank. It should be filled out in ink and forwarded, with the required five dollar deposit, to H. W. Geromanos, Dean, 316 Huntington Ave., Boston, Mass.

ADMISSION TO THE FIRST YEAR

The student intending to enter the School should bear in mind that the broader his intellectual training in any direction, and the more extensive his general acquirements, the greater will be the advantages he may expect to gain. The importance of thorough preparation in the subjects set for examination also is great; for the character and the amount of instruction given in the School from the outset, leave little opportunity for one, imperfectly fitted, to make up deficiencies, and render it impossible for him to derive the full benefit from his course, or perhaps even to maintain his standing. The training given in the best high schools will, in general, afford suitable preparation.

The requirements of age and scholarship specified are regarded as a minimum in all ordinary cases, and only exceptional circumstances will justify any relaxation. Parents and guardians, are advised that it is generally for the ultimate advantage of the student not to enter under the age of eighteen years.

ENTRANCE EXAMINATIONS IN BOSTON

Examinations for admission to the first year class will be held at 316 Huntington Avenue on June 11 and 12, and on September 9 and 10, 1914.

Students are advised to attend the June Examinations, if possible, in order that any deficiencies then existing may be made up in September, before entrance.

Examination Fees

Before taking the examination, the applicant must have filed his application, together with the required five dollar deposit. If he gets a clear record in his examinations, he may file his registration cards, together with the twenty dollar registration fee, at any time before school opens. If, however, he wishes to start practical work, he must register before being assigned to a position.

Order of Examinations

Thursday, June 11, 1914

9.45 A.M. to 10.00 A.M.	Registration of Applicants
10.00 A.M. to 12.00 N.	Algebra
1.00 P.M. to 3.00 P.M.	Plane Geometry
3.00 P.M. to 4.00 P.M.	Arithmetic*

Friday, June 12, 1914

10.00 A.M. to 12.00 N.	English
1.00 P.M. to 3.00 P.M.	Physics

SUBJECTS FOR EXAMINATION

To be admitted as a student of the first-year class, the applicant must have attained the age of seventeen years, and must have passed satisfactory examinations in the following subjects:—

Arithmetic*
Elementary Algebra
Plane Geometry
English
Elementary Physics

The examination in Physics is not required, but students not receiving a clear record in it, by examination or otherwise, will be required to take a special course in Physics, in addition to their regular first-year work.

The detailed requirements in the various subjects are as follows:—

Arithmetic

The ordinary arithmetical calculations which should be familiar to all grammar school graduates. The examination will call for a knowledge of:—addition, subtraction, division and multiplication, of whole numbers, decimals, and fractions. The student is also expected to have a reasonable knowledge of percentage computations, as used in common arithmetic, and square root. He will not be called upon to do any work in the computation of interest, either simple, or compound.

Not required in 1914.

Plane Geometry

The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the

*Not required in 1914.

circle and the measurement of angles; similar polygons; areas, regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

Algebra

The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one, or more, unknown quantities; problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative.

English

The examination in English will be as far as possible a test of the candidate's ability to express himself in writing in a manner at once clear and accurate.

The candidate will be required to write upon subjects familiar to him. His composition should be correct in spelling, punctuation, grammar, idiom and formation of paragraphs, and should be plain and natural in style. He will be judged by how well, rather than by how much he writes.

Physics

The candidate will be expected to be familiar with the fundamental principles of Physics. It is especially desirable that he should have a good knowledge of general mechanics and of the mechanics of solids, liquids and gases. A knowledge of physical hypotheses is comparatively unimportant. Text-book instruction should be supplemented by lecture-room experiments. A sufficiently extended treatment of the subject will be found in any of the principal text-books now in use in secondary schools. Ability to solve simple problems will be expected.

Certificates

A student obtaining an average of 80%, or over, during his high school course, in the subjects required for admission, may

be given credit in those subjects, without examination, upon application to the Dean. Such applications, together with a certificate from his principal, or instructor, stating the work done and the ranks received, shall be filed with the Dean, not less than ten days preceding the examination date.

Conditions

A candidate failing in only one, or two, of the examination subjects, may be admitted with "conditions." A candidate incurring conditions in June must repeat, in September, examinations in those subjects in which he has failed.

In any case of a condition existing after a second examination in a subject, special arrangements must be made with the Dean, before a student will be allowed to attend classes.

Modern Languages

There is no requirement in the modern languages for entrance to the School, and students who desire to take up these subjects during their course, may do so, provided they show the capacity to handle such work in addition to the required subjects.

OUTLINES OF SUBJECTS REQUIRED FOR ENTRANCE

By writing the Dean, prospective applicants may receive a brief outline covering the subjects in Physics and Algebra upon which the Entrance Examinations are based. These outlines are issued in order that the applicant may concentrate his study upon subjects that are essential to the work, and not spread his efforts over too large a field.

COURSES OF STUDY

General Information

The schedules of the various courses are given on the following pages. The first year work of all courses is practically the same, with a few exceptions, which are made because of the need of the student for elementary training in his professional subjects. This is done so that he may gain more from his early practical work, as well as be of more use to his employer, by reason of a better understanding of the duties he may be called upon to perform.

The school year comprises eighteen weeks of class work, and one week of examinations for each division, so by dividing the total hours of class work by eighteen, the number of hours per week in any subject may be readily determined. For example, if mathematics comes ninety hours per year, it will be given five hours per week. Some subjects are given double time, but only extend through half the year. The student is expected to spend from one to two hours in preparation, for every hour given over to class work, in all subjects except Drawing.

The number in parenthesis, following the subject in the "Outlines of Courses," is the number by which that subject is identified in the descriptive matter under "Subjects of Instruction."

The work is so planned that the student will be required to spend from 50 to 60 hours, in preparation and class work, during each school week.

When a student elects a Course, he is required to complete all subjects in that Course, not indicated as "Optional," in order to receive a diploma. No subject is to be dropped, or omitted, without the consent of the Dean.

CIVIL ENGINEERING

The purpose of this course is to give the student a broad education in those subjects which form the basis of all branches of technical education, and a special training in those subjects comprised under the term "Civil Engineering." It is designed to give the student sound training, both theoretical and practical, in the sciences upon which professional practice is based.

Civil Engineering covers such a broad field that no one can become expert in its whole extent. It includes Topographical Engineering, Municipal Engineering, Railroad Engineering, Structural Engineering, and Hydraulic and Sanitary Engineering. It covers land surveying, the building of railroads, harbors, docks and similar structures; the construction of sewers, water works, roads and streets; the design and construction of girders, roofs, trusses, bridges, buildings, walls, foundations and all fixed structures. All of these branches of Engineering rest, however, upon a relatively compact body of principles, and in these principles the students are trained by practice in the class-room, drawing room, the field and the testing laboratory.

The course is designed to prepare the young engineer to take up the work of assisting in the design and construction of structures; to aid in the location and construction of steam and electric railways, sewerage and water supply systems; and to undertake intelligently, supervision of work in the allied fields of mining, architectural, and electrical engineering and general contracting.

COURSES OF STUDY

I. Civil Engineering

First Year	Hours of Exercise
Mathematics I (10)	90
Physics I, Lectures and Recitations (20)	72
Physics I, Laboratory (21)	36
Elements of Electricity (126)	27
Descriptive Geometry I (42)	90
Mechanical Drawing (40)	72
Lettering (41)	18
English I (1)	54
Surveying I (50)	36
Surveying I, Fieldwork and Plotting (53)	108
Second Year	
Mathematics II (11)	72
Precision of Measurements (13)	9
Physics II, Lectures and Recitations (22)	54
Physics II, Laboratory (23)	36
Applied Mechanics I (30)	54
Descriptive Geometry II (43)	36
Topographical Drawing (54)	36
Mechanism (90)	27
Practical Electricity I, Lectures and Recitations (134)	36
Practical Electricity I, Laboratory (135)	36
English II (2)	36
Surveying II (52)	36
Surveying II, Fieldwork and Plotting (53)	108
Spherical Trigonometry (12)	9
Third Year	
Applied Mechanics II (31)	60
Railroad Engineering (57)	54
Railroad Engineering, Fieldwork and Drawing (58)	108
Theory of Structures (70)	30
Stereotomy (55)	36
Highway Engineering (56)	18
Theoretical Hydraulics (110)	54
Materials (81)	36
Practical Electricity II, Lectures and Recitations (136)	36
Practical Electricity II, Laboratory (137)	36
Metallurgy of Iron (147)	18
Dynamical and Structural Geology (160)	54
Fourth Year	
Structural Design (73)	108
Applied Mechanics Laboratory (34)	12
Theory of Structures, Bridges and Similar Structures (71)	90
Advanced Structures (72)	36
Advanced Railroad Engineering (59)*	18
Railroad Design (60)	54
Advanced Structures (72)	36
Hydraulic Motors (Optional) (111)	36
Hydraulic and Sanitary Engineering (112)	36
Concrete Construction (80)	36
Foundations (82)	18
Practical Electricity II, Lectures and Recitations (136)	36
Practical Electricity II, Laboratory (137)	36
Thesis	108

*Omitted in 1914-1915.

MECHANICAL ENGINEERING

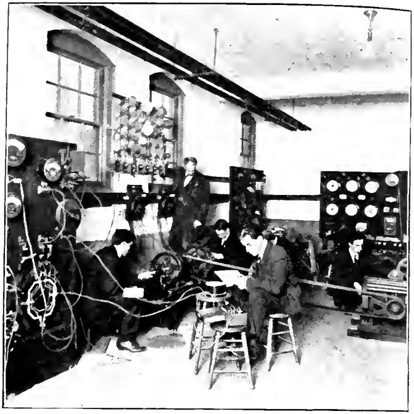
This course is designed to give a broad foundation in those fundamental subjects which form the basis for all professional engineering practice, and to especially equip the young engineer with a thorough knowledge of the various phases of Mechanical Engineering. The course embraces instruction by text-book, lecture, laboratory and work-shop practice, with special references to the following branches: Steam Engineering, Hydraulic Engineering, Power Plant Design, Machine Design, Applied Electricity, Heat Engineering, and allied fields of the engineering profession.

The course affords training in the methods, and gives practice in the process of Construction, which develops in the student the capacity for thinking along mechanical lines, thus enabling him to base all of his work upon fundamental principles already learned, rather than upon empirical rules. It is the endeavor to give the student a thorough theoretical training, and meanwhile devote sufficient time to the practical work, that he may become a proficient mechanical engineer both in theory, and in practice, in all of the various branches of Mechanical Engineering.

COURSES OF STUDY

II. Mechanical Engineering

First Year	Hours of Exercise
Mathematics I (10)	90
Physics I, Lectures and Recitations (20)	72
Physics I, Laboratory (21)	36
Elements of Electricity (126)	27
Descriptive Geometry I (42)	90
Mechanical Drawing (40)	144
Lettering (41)	18
English I (1)	54
Second Year	
Mathematics II (11)	72
Precision of Measurements (13)	9
Physics II, Lectures and Recitations (22)	54
Physics II, Laboratory (23)	36
Applied Mechanics I (30)	54
Descriptive Geometry II (43)	36
Mechanical Engineering Drawing (91)	144
Mechanism (90)	45
Practical Electricity I (134)	36
Practical Electricity I, Laboratory (135)	36
English II (2)	36
Woodworking and Patternworking (Optional) (102)	54
Foundry Practice (99)	9
Third Year	
Applied Mechanics II (31)	60
Heat Engineering, Thermodynamics (95)	54
Heat Engineering, Boilers (95)	36
Valve Gears (90)	27
Machine Drawing (92)	144
Boiler Drawing (100)	36
Theoretical Hydraulics (110)	54
Materials (81)	36
Practical Electricity II, Lectures and Recitations (136)	36
Practical Electricity II, Laboratory (137)	36
Metallurgy of Iron (147)	18
Machine Work (103)	54
Forging, Chipping and Filing (Optional) (101)	36
Fourth Year	
Applied Mechanics III (33)	36
Applied Mechanics Laboratory (34)	12
Dynamics of Machines (94)	36
Machine Design (93)	144
Engineering Laboratory (97)	72
Hydraulic Motors (111)	36
Power Plant Design (96)	54
Concrete Construction (80)	36
Foundations (82)	18
Refrigeration (Optional) (98)	18
Thesis	108



CLASS IN DYNAMO TESTING
Determining the Characteristics of a Direct Current Shunt Generator

IN THE RESEARCH LABORATORY
A. D. Little Co., Inc. Engineering Chemists
Hydrolyzing Wood Fiber into Alcohol

CLASS IN SURVEYING FIELD WORK
Making a Stadia Survey of Jamaica Pond

ELECTRICAL ENGINEERING

Electrical Engineering having in recent years developed along lines demanding a thorough appreciation of physical theory, as well as a broad working knowledge of Mathematics, it is essential that students planning to take this course should realize the fundamental necessity of obtaining a solid grounding in these subjects upon which to build.

It is not the purpose of the course to attempt the impossible aim of turning out fully trained engineers in the various branches of the science, especially as it is becoming daily more and more differentiated and specialized; but rather to lay a broad and thorough foundation for future progress along the lines of work which may particularly appeal to the individual, by giving him a good working acquaintance with the essential principles, which underly each of the more specialized branches of professional activity. Parallel with the theoretical work runs a carefully planned course of laboratory work which is intended to develop the student's powers of accurate observation of planning work and methods for himself, with due regard to saving of time and precision of results. For more detailed matters, the reader is referred to the description of the several courses and subjects of instruction.

COURSES OF STUDY

III. Electrical Engineering

First Year	Hours of Exercise
Mathematics I (10)	90
Descriptive Geometry I (42)	90
Lettering (41)	18
English I (1)	54
Physics I, Lectures and Recitations (20)	72
Physics I, Laboratory (21)	36
Mechanical Drawing (40)	144
Elements of Electricity (126)	27
Second Year	
Mathematics II (11)	72
Precision of Measurements (13)	9
Physics II, Lectures and Recitations (22)	54
Physics II, Laboratory (23)	36
Applied Mechanics I (30)	54
Descriptive Geometry II (43)	36
Mechanical Engineering Drawing (91)	72
Mechanism (90)	36
Direct Current Machinery (128)	18
Direct Current Practice (129)	18
English II (2)	36
Theoretical Electricity (127)	27
Methods of Wiring and National Code (131)	9
Electrical Engineering I, Laboratory and Reports (122A)	72
Woodworking and Patternwork (Optional) (102)	54
Third Year	
Applied Mechanics II (31)	45
Heat Engineering: Thermodynamics (95)	54
Electrical Engineering II, Laboratory and Reports (122 B)	63
Technical Electrical Measurements (130)	18
Machine Drawing (92)	72
Hydraulics (110)	54
Alternating Currents, Lectures, Recitations and Problems (138)	45
Alternating Current Machinery, Lectures, Recitations and Problems (139)	63
Alternating Current Laboratory and Reports (139 A)	45
Forging, Chipping, and Filing (Optional) (101)	54
Construction and Operation of Intercommunicating Telephones (Optional) (124)	6
Fourth Year	
Studies in Electrical Construction (123)	27
Applied Mechanics Laboratory (34)	12
Illumination and Photometry (132)	18
Central Stations (121)	18
Electric Railways (133)	27
Hydraulic Motors (111)	36
Electrical Engineering III, Laboratory and Reports (122 C)	60
Alternating Current Machinery, Lectures and Recitations (139)	36
Alternating Current Machinery, Laboratory and Reports (139 A)	30
Electrical Transmission of Power (120)	18
Metallurgy of Iron (147)	18
Surveying I A (50 A)	36
Engineering Laboratory (97)	36
Machine Work (Optional) (103)	54
Thesis	108

CHEMICAL ENGINEERING

During the great industrial advance of recent years, chemical industry has been in the front rank of progress, and perhaps the most potent reason for this, may be found in the replacement by scientific guidance, of the old rule of thumb methods.

Again, owing to the keenest competition, manufacturers have been compelled to utilize every product of their plants and this has called for skilled chemical knowledge.

The Course in Chemical Engineering has, for its purpose, the training of students competent to take responsible places in the operation of industries based on chemical principles.

During their course, the students are employed in chemical industries, as gas manufacturing plants, chemical engineering companies, etc., so that they not only get an excellent training in the theory of such work at school, but get a thorough familiarity with the technical side of the industry, as well.

The class work includes a training in Inorganic, Analytical, Organic, and Industrial Chemistry, which is accompanied by appropriate laboratory work.

In addition to the foregoing subjects, the student is given a good knowledge of mechanical and electrical subjects, as Drawing, Applied Mechanics, Direct Current Practice, Technical Electrical Measurements, etc., which are taken up in a way to give them especial bearing on the work of the Course.

COURSES OF STUDY

IV. Chemical Engineering

First Year	Hours of Exercise
Mathematics I (10)	90
Physics I, Lectures and Recitations (20)	72
Physics I, Laboratory (21)	36
Elements of Electricity (126)	27
Descriptive Geometry I (42)	90
Mechanical Drawing (40)	54
Lettering (41)	18
English I (1)	54
Inorganic Chemistry, Lectures, Laboratory and Recitations (142)	144
German I (170)	54

Second Year	
Mathematics II (11)	72
Precision of Measurements (13)	9
Physics II, Lectures and Recitations (22)	54
Physics II, Laboratory (23)	36
Applied Mechanics I (30)	54
Descriptive Geometry II (43)	36
Mechanical Engineering Drawing (91)	72
Mechanism (90)	36
Qualitative Analysis (143)	108
Quantitative Analysis (144)	54
English II (2)	36
German II (171)	54

Third Year	
Applied Mechanics II (31)	60
Heat Engineering, Thermodynamics (95)	54
Organic Chemistry (145)	36
Organic Chemical Laboratory (145)	90
Machine Drawing (92)	72
Direct Current Practice (129)	18
Theoretical Hydraulics (110)	54
Technical Electrical Measurements (130)	18
Electrical Engineering Laboratory I (122 A)	72

Fourth Year	
Theoretical Chemistry (149)	54
Applied Mechanics Laboratory (34)	12
Industrial Chemistry (146)	54
Industrial Chemical Laboratory (146 A)	108
Organic Chemistry (145)	36
Organic Chemical Laboratory (145)	90
Engineering Laboratory (97)	36
Heat Measurements (24)	18
Thesis	108

SUBJECTS OF INSTRUCTION

Instruction is given by lectures and recitations, and by practical exercises in the field, the laboratories, and the drawing-rooms. A great value is set upon the educational effect of these exercises, and they form the foundation of each of the four Courses. Text-books are used in many subjects, but not in all. In many branches, the instruction given differs widely from available text-books; and, in most of such cases, notes on the lectures and laboratory work are issued, and are furnished to the students. Besides oral examinations in connection with the ordinary exercises, written examinations are held from time to time. At the close of the year, in May and June, general examinations are held.

In the following pages will be found a more or less detailed statement of the scope, as well as the method of instruction, of the subjects offered in the various Courses. The subjects are classified, as far as possible, related studies being arranged in sequence.

The subjects are numbered, or lettered and numbered, for convenience of reference in consulting the various Course Schedules. As the total number of hours per term devoted to a subject sometimes varies in different Courses, these hours are not in every case given in connection with the following descriptions.

The requisites for preparation, include not only the subjects specified by number, but also those required as a preparation for them. The reason for this is that to properly carry on the more advanced subjects, the student must have become proficient in all subjects necessary for a clear comprehension of the last subject. Some studies specified as being required in preparation, may be taken simultaneously. The student must complete such subjects before starting on more advanced work.

By careful consideration of the Course Schedules, in connection with the following Description of Subjects, the appli-

cant for a special Course may select, for the earlier part of that Course, such subjects as will enable him to pursue later those more advanced subjects which he may particularly desire.

Applications for exception, for sufficient causes, from the required preparation, as stated in connection with each subject described below, will always be considered by the Dean.

The topics, included in the list which follows, are subject to change at any time by action of the School authorities.

SYNOPSIS OF COURSES

1. English I.

This is a course in the principles of composition and letter writing. Special attention is given to spelling, punctuation and grammar.

The chief object of the work is to enable the student to write correct, lucid and easy business English.

2. English II.

PREPARATION: 1.

This Course is a continuation of English I and is devoted to writing business letters, to descriptions of processes and machinery, and to all other possible means of enabling the student to express himself with accuracy and precision, both orally and in writing.

10. Mathematics I.

PREPARATION: ALGEBRA, GEOMETRY.

Variation, logarithms, slide rule, exponential equations, the uses of formulas in Physics and Engineering.

Trigonometry, including circular measure, co-ordinates, trigonometric ratios, formulas, law of sines, law of cosines, solution of right and oblique triangles, applications to problems in Physics and Engineering, Elements of Spherical Trigonometry.

11. Mathematics II.

PREPARATION: 10.

Co-ordinates, plotting of functions, interpolation, the straight line, curves represented by various equations, graphic solution of equations, determination of laws from the data of exper-

iments. Rate of increase, differentiation, determination of maxima and minima by differentiation, integration, definite integrals, determination of mean value, area and volume by integration, center of gravity, moment of inertia, partial differentiation.

12. Spherical Trigonometry (Required in Course 1).

PREPARATION: 10.

This course consists of nine recitations during the first part of the second year. A study is made of the proofs of formulas of right and oblique spherical triangles, and their application to surveying and other engineering problems.

13. Precision of Measurements.

PREPARATION: 10.

This course, which is required of all students in the second half of the second year, comprises a thorough discussion of the fundamentals of the Theory of Measurements, including a study of the Sources of Error, the Best Representative Value of the result of a series of measurements, the determination of the several Precision Measures of the result of one's work, the converse problem of how best to proceed in order to reach a given degree of precision, and a thorough consideration of the proper use of Significant Figures. The text-book is Goodwin's Notes on Precision of Measurements.

20. Physics I.

The subjects considered are general mechanics, molecular mechanics, wave-motion and optics, which topics are discussed both mathematically and experimentally. It is the purpose of the course to lay a thorough foundation for subsequent study of experimental, and technical physics. Hence it is planned with immediate reference to familiarizing the pupil with the fundamental principles of the science. The lectures are illustrated by suitable experiments.

21. Physical Laboratory I.

PREPARATION: 20.

A Course of experimental exercises in the first year, laid out individually for each student. The experiments are correlated, so far as practical, with the lecture and class-room work,

the first year being devoted to experiments in mechanics. The use of the various instruments of precision is taught, as far as may be, in connection with experiments, each of which illustrates some different method, or principle. The experiments relate to the mechanics of solids, liquids, and gases.

22. Physics II.

PREPARATION: 20.

A Course of experimental lectures which is a continuation of Physics 1. In this work the student completes the study of physics started in Physics 1.

23. Physical Laboratory II.

PREPARATION: 22.

A series of experiments in the second year, correlated as far as practicable with the lecture course. The experiments in Optics include the use of a compound microscope, the determination of the focal length of lenses, gas photometry, indices of refraction, and elementary spectrum analysis. All work is strictly quantitative, and the attention of the student is especially directed to the precision discussion of his results.

24. Heat Measurements.

PREPARATION: 22.

A Course in which is studied the various methods of measuring high temperatures by pyrometric methods. The experimental work includes the use of the thermo-electric, calorimetric, and electric resistance, pyrometers, together with selected experiments giving instruction in the use of Seger Cones, heat treatment of steel, tempering, etc.

30. Applied Mechanics I.

PREPARATION: 10, 11, 20, 22.

The Course comprises a study ot statics, consisting of the general methods and applications of statics, including the determination of the reactions, stresses in frames; of distributed forces, center of gravity; of moment of inertia, radius of gyration of plane areas and solids, including principal axes and principal moments of inertia; of kinematics and dynamics, including the equations for uniform and varying rectilinear and curvilinear motion, centrifugal force, unresisted projectile,

pendulum, harmonic motion, rotation, combined rotation and translation, momentum and angular momentum, center of percussion, impact, work, power and kinetic energy.

31. Applied Mechanics II.

PREPARATION: 30.

This Course comprises a study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to tension, to compression and to shearing; common theory of beams, with thorough discussion of the distribution of stresses, shearing forces, bending moments, slopes and deflections.

A study is also made of the strength of columns, shafts and springs.

32. Applied Mechanics II A.

PREPARATION: 30.

A brief Course covering the subjects treated in Applied Mechanics II, but in a shorter time.

Required in Course III.

33. Applied Mechanics III.

PREPARATION: 31.

A Course treating of the laws of friction, including a study of the distribution of friction on shaft journals and pivots; also a study of the transmission of power by belting and by ropes, and of the friction reducing power of lubricating oils. A study is also made of the continuous girder, so planned as to apply to beams, and applications of the principles of Mechanics and of the Strength of Materials to the design of other forms of simple structures.

34. Applied Mechanics Laboratory.

PREPARATION: 31.

The tests made by the students in the Applied Mechanics Laboratory include tests to determine the modulus of elasticity, limit of elasticity, yield point and tensile strength of steel bars; tests of the deflection and of the transverse strength of a wooden beam subjected to a transverse load; tests to determine the modulus of elasticity and tensile strength of wire; tests on cement mortars, including practice in laboratory methods.

40. Mechanical Drawing.

The Course extends through the first year. The instruction in Mechanical Drawing relates to the drawing instruments and materials, instrumental constructions and the drawing of irregular curves, tracing in ink, conventions, lettering, dimensioning and working methods. The work includes several drawings of machine details.

41. Lettering.

The work consists of letter drawing and stroke lettering for working drawings. The instruction is given by short lectures on the principles and processes of freehand drawing, and by individual criticism. The latter part of the course is devoted to further work in letter drawing and stroke rendering, and the construction of title designing.

42. Descriptive Geometry I.

The Course covers the simpler problems on the point, line and plane and various constructions in the projection of solids, including sections and developments.

In the latter half of the course, the problems on the line and plane are completed, and the projection of solids is continued through the intersection of solids bounded by plane faces. Isometric drawings and several practical applications are given.

43. Descriptive Geometry II.

PREPARATION: 42.

The Course is a continuation of Descriptive Geometry I, and deals with single and double curved surfaces; their intersection by oblique planes, tangent planes, penetrations, development, and so forth.

50. Surveying I.

PREPARATION: 10, 11.

This Course consists of two lectures, or recitations, per week during the first year. The student is taught the theory of the various instruments used in plane surveying, the methods of carrying out various surveys, and the application of contour maps to the solution of problems of drainage, road location, landscape engineering, etc. The text-book used is The

Principles and Practice of Surveying by Profs. Breed and Hosmer, Vol. I.

50A. Surveying I A.

This is a brief Course for students taking Courses II and III, to give them instruction in the essential principles of surveying practice.

51. Surveying I (Fieldwork and Plotting).

PREPARATION: 50.

This Course is taken simultaneously with Surveying I, and consists of six hours of exercise per week throughout the year. The student is taught the use of the chain, tape, compass, transit, and various forms of leveling instruments. The work in the drawing room consists in making the computations which arise in the work of a surveyor, and in making scale drawings by the methods in common use.

52. Surveying II.

PREPARATION: 50, 51, 12.

This Course is a continuation of Surveying I, and consists of two lectures, or recitations, per week throughout the second year. The student is taught the theory of the stadia and plane table in topographic surveying, the methods of making astronomical observations, and of conducting city and photographic surveys. The text-books used are The Principles and Practice of Surveying by Profs. Breed and Hosmer, Vols. I and II.

53. Surveying II (Fieldwork and Plotting).

PREPARATION: 52.

This Course is taken simultaneously with Surveying II and consists of six hours of exercise per week throughout the second year. A stadia survey is first made and later a topographical map made from the notes taken in the field. The practice of plane table surveying, the determination of elevations by barometer, and the conduct of photographic surveys are also studied.

54. Topographical Drawing.

PREPARATION: 50, 52.

This Course consists of two hours of exercise per week throughout the year. A study is made of the different topographical

signs used on surveying maps, both in pen and ink and in wash color. Each student is required to make a number of plates of each kind of topography, and to become reasonably proficient in the making of topographical maps.

55. Stereotomy.

PREPARATION: 40, 42, 43.

This Course consists of three hours of exercise per week throughout the year. The student studies the applications of descriptive geometry to the making of drawings for masonry structures, such as intersecting arches and walls, abutments, piers and culverts. The text-book is a set of specially prepared notes on Stereotomy.

56. Highway Engineering.

PREPARATION: 57.

This Course consists of one lecture, or recitation, a week throughout the year. A study is made of the principles governing the location, construction, and maintenance of roads, and the construction and maintenance of the various kinds of pavements for city streets. The text-book used is Baker's work on Roads and Pavements.

57. Railroad Engineering.

PREPARATION: 50, 51, 58.

This Course consists of three hours of exercise a week throughout the year. A study is made of the mathematics of the various curves used in engineering, with their application to the location of railroads, highways, sewers, pipe lines, etc. The easement curve is also studied, and the various methods of staking out and computing earthwork. The text-books used are Prof. Allen's Railroad Curves and Earthwork, and his Field and Office Tables.

58. Railroad Fieldwork and Drawing.

PREPARATION: 57.

This Course consists of six hours of exercise a week throughout the year. A reconnoissance is first made of a railroad about a mile and a half in length, followed by a preliminary survey with transit and level for the determination of contours, as a basis for fixing the location survey. All this work follows modern practice in laying out railroads. The greater

part of the fieldwork is devoted to a systematic drill in running in curves of various kinds, including transition curves, and in staking out fieldwork. The drawing consists in plotting up the preliminary survey of the railroad surveyed.

59. Advanced Railroad Engineering.

PREPARATION: 58.

This Course consists of one exercise a week throughout the year. The following subjects are treated: maintenance of way, the economies of railroad location, including the study of train resistance and the influence of grade, distance, rise and fall, and curvature; rolling stock and motive power brakes, signals, yards and tunnels, and street railroads. Each student is given an individual problem on the design of an interlocking plant, and also problems on railroad practice. The text-books are Tratman's Track and Trackwork and also neostyled notes.

60. Railroad Design.

PREPARATION: 59.

This Course consists of three hours a week in the drawing room throughout the fourth year. The design of freight yards and terminals is studied, and each student is required to solve individual problems on practical railroad design.

70. Theory of Structures.

PREPARATION: 31.

This is a Course of thirty exercises in the third year, devoted to class and drawing-room work in studying the loads, reactions, shears and moments acting upon structures of various kinds as roofs and bridges. A thorough study is also made of the various functions of the influence line and the methods used to determine the position of moving loads to produce maximum shears and moments on bridges. The text-book used is Prof. Spofford's Theory of Structures.

71. Theory of Structures, Bridges and Similar Structures.

PREPARATION: 70.

This Course treats of the computation and design of structures of wood, steel and masonry, by analytical and by graphical methods. The subjects considered are: the plate girder, roof and bridge trusses of various forms, trestles of wood and

steel, and arches of metal, stone, and concrete. The object is to train the student thoroughly in the application of the principles of mechanics to the design of structures. The text-book used is Prof. Spofford's Theory of Structures.

72. Advanced Structures.

PREPARATION: 71.

This Course treats of the computation and design of retaining walls, masonry dams, masonry arches, continuous girders, movable bridges and skeleton frames for buildings. Only the more simple cases are considered.

73. Structural Design.

PREPARATION: 72.

A Course of six hours per week, throughout the fourth year, in which the students are instructed in the design of structures of wood, stone and metal. Each student is given a set of data, and is required to perform all the computations and to make designs and working drawings for several structures, such as a masonry dam, a plate girder bridge, and a wooden roof truss. His work is criticized as it progresses.

80. Concrete Construction.

PREPARATION: 72.

A Course consisting of lectures and drafting, in which instruction is given in the theoretical and practical principles involved in the design of structures of plain and reinforced concrete. The Course includes a study of the simple reinforced concrete beam, the design of slabs, T-beams, columns and footings. Instruction is given by means of lectures and text-books, in conjunction with which each student is given practical problems in design to be worked out in the drawing room.

81. Materials.

PREPARATION: 72.

This Course consists of two lectures, or recitations, per week throughout the third year, in the study of the methods of manufacturing, properties and strength of various materials used by the engineer, such as brick, cement, concrete, iron and steel. A study is also made of the properties of wood and stone. The text-book used is Johnson's The Materials of Construction.

82. Foundations.

Preparation: 71.

A Course of eighteen lectures during the fourth year. The subjects treated in this Course are as follows: Building stones and concrete, bearing power of different kinds of soil, examination of the site, designing the footings, whether of masonry, or of steel and concrete, independent piers, pile foundations, compressed air processes, freezing processes, retaining walls, together with some details of buildings for industrial purposes, constructed of steel, or of reinforced concrete. Baker's Masonry Construction is used as a text-book.

90. Mechanism and Valve-Gears.

Preparation: 11, 10, 12.

This Course includes a systematic study, not only of the motions and forms of the various mechanisms occuring in machines, and the manner of supporting and guiding the parts, independently of their strength, but also of the design of gear-teeth. The course also includes the theory and practice of designing valve-gears for steam-engines, including the plain slide valve, link motions, radial valve-gears, double valves and drop cut-off valves.

91. Mechanical Engineering Drawing.

Preparation: 40, 90.

The construction includes the drawing of simple machine details, such as bolts and nuts, screws, springs, keys, flanges, pipe fittings, etc.; teaching systems of dimensioning, conventional representations, and blue-printing. The latter part of the work consists of drawing, illustrating the class-room work in connection with the courses in Mechanism and Valve-gears, including the design of cams, gear-teeth, slide-valves, double valves, the Stephenson link, etc.

92. Machine Drawing.

Preparation: 91.

The aim of the Course is to teach the proper way of making the necessary dimensioned drawings for use in practice, good shop systems being adopted. The instruction includes the making of working detail and assembly drawings of machinery from measurements.

93. Machine Design.

PREPARATION: 91, 31.

The main object of the Course is the application of principles already learned to the solution of problems in design. Each student makes a number of complete designs, such as a boiler, a large shaft with pulleys and gears, a set of couplings, a power shear, geared pump, etc. For each design the constructive details are carefully discussed; each student then makes all the necessary calculations to determine the dimensions of every part, and finally he completes the working drawings. The scope of the designs is such as to include most of the elementary principles of design, and yet is sufficiently limited to enable the student to complete every detail, as it is believed that only by such thorough work can real benefit be obtained.

94. Dynamics of Machines.

PREPARATION: 90, 93.

The Course in Dynamics of Machines includes a number of the principal applications of Dynamics to moving machinery such as governors, fly-wheels, the action of the reciprocating parts of the steam-engine, running balance, whirling speed of shafts, etc. The work is supplemented by a course in drafting.

95. Heat Engineering: Thermodynamics and Boilers.

PREPARATION: 10, 11, 31.

It includes a study of the principles of thermodynamics; a discussion of the properties of gases, saturated and superheated vapors, especially of air and steam; of the flow of fluids through orifices, nozzles, pipes and meters, a discussion of the action of the steam injector; a study of the various cycles of the hot air, internal combustion and steam engines, of the turbine, air compressor and refrigerator systems. These engineering applications are treated from the physical, analytical and graphical points of view, so as to give the student a good foundation in the principles of thermodynamics, in the solution of actual heat engineering problems. The Course also includes a study of the simple, compound and multiple expansion steam engine, of the different types of gas engines, of the gas producer, of compressed air and refrigerator machines, and the methods of testing such machines.

The latter part of the Course includes a study of the various types of steam boilers and the different kinds of power plants.

96. Power Plant Design.

PREPARATION: 31, 93, 95.

The Course consists largely of drawing-room work and calculations, with such lectures as may be needed from time to time. The work of the Course consists in making the working drawings necessary to show the location of boilers, engines, auxiliaries, piping, coal pockets, etc., for a power house, and also drawings and calculations of some of the details.

97. Engineering Laboratory.

PREPARATION: 95.

This Course consists of exercises and tests upon the various forms of appliances in use in the power plant, such as:

Boiler Test
Steam Engine Testing
Steam Turbine Testing
Fans and Blowers
Pumps—Centrifugal and Duplex
Condensers
Feed Water Heaters
Flue Gas Analysis

98. Refrigeration.

PREPARATION: 95.

The Course covers a study of the principles underlying refrigeration processes, together with a discussion of the properties of various refrigerants and the common types of refrigerating machines and systems. In connection with the work, visits are made to plants where artificial refrigeration is used.

99. Foundry Practice.

A lecture Course dealing with coring, ramming, venting, facing, spruing, use of risers, etc., as used in flask moulding. Various forms of moulding machines, as power squeezer, hinged, and turn over are studied. Foundry appliances for pouring are discussed.

100. Boiler Design and Drawing.

PREPARATION: 95.

This Course is devoted to a consideration of the most modern methods of boiler designing and construction, and in connection with the lecture Course, the student is required to make drawings from specifications, illustrating the principles of the design and also the details of a modern boiler.

101. Forging, Chipping and Filing.

This Course consists of one two-hour exercise per week, or its equivalent. In the forging work, the student is instructed in the building and care of fires, heating, drawing, bending, upsetting and welding.

The exercises in Chipping and Filing give instruction about the various tools and files used, and then the student is given practice in their use by various problems in chipping chamfers, keyways, etc.; and then in filing problems, as parallel surfaces, filing to template, slide and drive fits, etc.

102. Wood-working and Pattern Work.

This is a Course designed to give students facility in the common operations of carpentering and cabinet work, together with the use and care of wood working machinery, as lathes, saws, planers, etc. The Course includes instruction in Woodturning having special application to Pattern-work, an illustrated discussion of the principles of moulding, to explain clearly and show reasons for "Draft" on patterns and methods of allowing it, instruction in the use and making of core-boxes, and methods of building up patterns.

103. Machine Work.

This Course is to train students in the common operations of metal working, as chipping and filing, forging, and machine work, as that done on lathes, drill presses, shapers and milling machines.

110. Theoretical Hydraulics.

PREPARATION: 31.

A Course of three exercises per week during the third year, with the solution of numerous problems, covering the principles of liquid pressure, the flow of water through orifices and

open channels, also through orifices and nozzles, and the losses from friction and other sources. Russell's Hydraulics is used as a text-book.

111. Hydraulic Motors.

PREPARATION: 110.

A series of exercises, mainly recitations, based upon a text-book, so as to embrace the laws of flow in open channels, and of the dynamic pressure and work of water flowing over curved surfaces. The time is principally given, however, to a study of impulse wheels and reaction turbines, with reference to their proper construction, regulation and testing, and to the various sources of loss of energy in their operation.

112. Hydraulic and Sanitary Engineering.

PREPARATION: 110.

This Course treats of the drainage of lands, together with a Course in irrigation, in which are studied the constructions and methods employed in this and other countries, including the arrangement and proportioning of canals, distributaries, falls, regulators and other special works and modes of applying water to the soil. The subject of water supply is taken up, and embraces the study of the quantity of water required for city and town supplies, estimation of the yield from drainage basins, stream flow and ground water flow, and computations to determine the necessary storage to insure a given supply. The student is instructed in the use of hydraulic diagrams and the various methods used in stream gaging. The text-books used are Wilson's Irrigation Engineering, and Swan and Horton's Hydraulic Diagrams.

120. Electrical Transmission of Power.

PREPARATION: 128, 139.

This Course is devoted to a thorough study of the design and construction of modern high tension transmission lines. It is in two sub-divisions, the first dealing with the electrical characteristics of the line, such as: potentials used, size and spacing of conductors, inductive and capacity reactance, skin effect, coronal loss, effect of harmonics, conditions of resonance, effect of high tension lines on neighboring circuits, etc.; the second, covering the parallel problems of rights of way, loca-

tion of poles, towers and conduits, insulation and insulating devices, protective devices against lightning, flash overs, etc., and, in brief, a discussion of the problem of material realization of the line, as previously planned and calculated.

121. Central Stations.

PREPARATION: 111, 95, 128, 139.

This Course is given to a consideration of the central station for the production of electrical power, by both Steam and Hydraulic prime movers. Very little time is given to the consideration of either steam engines, steam or hydraulic turbines, or electric generators, transformers, etc. The time is taken by a careful discussion of the problems of development of a water power, and location of a steam plant, probable field for consumption of power developed, organization of the plant, design, etc. Particular attention is given to the problems of control, protection of apparatus, and switchboard devices. The Course is in the form of lectures with free use of published descriptions of existing plants, collateral reading, etc.

122 A. Electrical Engineering I, Laboratory and Reports.

PREPARATION: 126, 128.

This Course of exercises is given throughout the second year, and is devoted to a carefully selected series of experiments intended to exemplify in the simplest manner the use of the voltmeter, ammeter and wattmeter, on the one hand, and on the other, a series of experiments illustrative of the principles developed in the courses on Direct Current Machines and Direct Current Practice. The purpose of this Course being, in part, to develop correct methods of work, it is intended that practically the whole of the preparatory work and working up of results shall be done in the laboratory, under guidance of the instructor, so far as necessary.

122 B. Electrical Engineering II, Laboratory and Reports.

PREPARATION: 122 A.

In this Course there are two lines of work pursued, first a set of experiments involving the use of instruments and the making of measurements, such as Specific Resistance, Insulation Resistance, Conductivity, use of the Cary Foster Bridge, Hoopes Bridge, Potentiometer, for the calibration of volt-

meters, and ammeters, etc. All through, particular stress is laid on the correct use of apparatus and methods, and precision methods are enforced throughout.

The second line of work is a continuation of the work in No. 122 A, the experiments being in some cases repeated, but the work being pursued now from the quantitative, rather than the qualitative, side. Thus, where in No. 122 A the Proney brake was used merely as a means for loading a motor and observing its action under load, it is here used as a measuring device in obtaining the motor efficiency and its errors and necessary corrections, as such, are studied.

122 C. Electrical Engineering III, Laboratory and Reports.

PREPARATION: 122 B.

This Course is given over to a series of experiments involving advanced Electrical Testing, and in it the student is thrown entirely upon his own resources, a desired result is stated to him, and he is required to plan out his own method, settle upon the apparatus needed, solve his precision requirements, calibrate his instruments, if necessary, and finally turn in a detailed report covering all phases of his work.

123. Studies in Electrical Construction.

PREPARATION: 120, 121.

This Course, which is given in connection with No. 120 and No. 121 consists of visits to plants, manufactories, etc., so far as possible, and written papers by the students upon the various questions involved, together with the reading of the same and their discussion by the class.

124. Intercommunicating Telephones.

PREPARATION: 126.

A Course of lectures in the construction, operation and maintenance of factory intercommunicating telephone sets.

126. Elements of Electricity.

PREPARATION: 10, 20.

This Course of 27 experimental lectures is taken by all students of the School during the first year. In it are discussed the fundamental principles of Magnetism, Electro-statics and Electro-kinetrics, the subjects being discussed from the view

point of the most recent hypotheses regarding the nature of Electricity and its modes of manifestation. The text-book used is Kimball's Physics.

127. Theoretical Electricity.

PREPARATION: 126, 128, 129.

This Course, taken during the second year, covers such subjects as the comparison of the Electrostatic and Electro-magnetic systems of measurement, the determination of the absolute units of potential difference, current, and resistance, with their relationship to the various International Units, and other similar matters; a consideration of the transfer of electricity through solid, liquid and gaseous conductors, concluding with a discussion of the Electronic Theory. No one text-book is used.

128. Direct Current Machinery.

PREPARATION: 126, 127.

This Course, which runs parallel with No. 127, returns to the starting point of the inducing of an Electromotive force by motion of a conductor in a magnetic field, and discusses in detail the theory of direct current generators and motors, armature winding, characteristic curves, etc. The text-book is Franklin and Esty; Direct Current Machinery.

129. Direct Current Practice.

PREPARATION: 128.

In this Course, which follows immediately after No. 128, requiring it as preparation, is given some detailed study of the operation of direct current apparatus, the Edison 3-wire system of distribution, storage batteries, and the more important industrial applications of direct current power.

130. Technical Electrical Measurements.

PREPARATION: 128, 129.

This Course, given in the third year, is intended to familiarize the student with the principle types of electrical measuring instruments used in testing, their manner of use, sources of error and necessary precautions to be taken, as well as the leading methods of measuring with precision, the various elec trical quantities as,—Resistance, Current, Electromotive force, Capacity, Inductance, Conductivity, etc.

131. Wiring and the National Code.

PREPARATION: 126.

This Course does not pretend at all to teach the student so called "Practical Wiring," but is intended to explain the principles governing the wiring of buildings, to illustrate the leading types of fittings used, and to give a careful survey of the requirements of the National Electrical Code, as promulgated by the Electrical Committee of the National Fire Protection Association, and adopted into their municipal law by all the leading cities and towns of the United States and Canada.

132. Illumination and Photometry.

PREPARATION: 20.

A Course of lectures dealing with the application of electricity to lighting, the principles of illumination, and the laboratory measurement of the various quantities concerned. The text-book used is Wickenden's Illumination and Photometry.

133. Electric Railways.

PREPARATION: 128, 129, 139.

A Course of lectures, including a discussion of the general problem of supplanting steam with electric traction, followed by a discussion of the principle systems of electric traction, namely, Direct Current, high and low voltage, Single Phase Alternating Current systems and Three Phase Alternating Current systems, and a study of the construction, equipment, and cost of operation of existing systems.

134. Practical Electricity I.

PREPARATION: 10, 20, 126.

This Course is given to all students in the Civil and the Mechanical Engineering Courses. The principles of electricity and magnetism discussed in Elementary Electricity are applied in this Course to the solution of practical problems of the two and three wire direct current systems, and to the study of direct current generators and motors. The student will also be instructed in wiring, together with the rules of the National Electrical Code.

135. Practical Electrical Laboratory I.

PREPARATION: 134.

A series of twelve practical experiments illustrating and depending on the problems and principles given in Practical Electricity I. Elementary tests on direct current machines.

136. Practical Electricity II.

PREPARATION: 134, 135.

This is a continuation of Practical Electricity I. The first part of the year will be devoted to a study of storage batteries, photometry, and the general principles of Alternating Current, series and parallel circuits. The last half of the year will be devoted to a study of the various types of Alternating Current Machinery and the application to present day conditions.

137. Practical Electrical Laboratory II.

PREPARATION: 136.

Twelve experiments on the testing of electrical machinery, both direct current and alternating current, also photometry of incandescent lamps.

138. Alternating Currents.

PREPARATION: 128, 129.

This Course concerns itself with the general theory of alternating current circuits, and the application of these principles to various engineering problems. In connection with the work, considerable importance is attached to the solution of problems selected with reference to their engineering application.

139. Alternating Current Machinery.

PREPARATION: 138.

This Course of lectures, recitations and problems, is devoted to a careful discussion of the various types of alternating current machinery for the generation, transmission and distribution of power. The special properties of each machine are considered for the machine as a unit, and when it is used as a part of any electrical system; some of the general considerations concerning long-distance power transmission are also included.

139A. Alternating Current Laboratory.

PREPARATION: 138, 139.

The work includes such tests as efficiency, heating, regulation and determination of characteristics for alternating current machinery. The work in the laboratory is supplemented by conferences.

140. Chemistry E I.

This is an experimental lecture Course covering chemical practice as applied to engineering work. It treats of the gases used in the arts, as hydrogen, oxygen, acetylene, etc.; their preparation, properties and uses, as well as the oxyhydrogen blow pipe, oxy-acetylene blast, etc. Paints, concrete, alloys, corrosion and its preventives, are also dealt with. In addition to this, the work takes up oils, fuels, fuel gases, explosives, glass, mineral insulators, the commonly used acids and bases, etc. The consideration is taken up from the engineer's standpoint, rather than the chemist's.

141. Chemistry E II.

PREPARATION: 140.

This is a continuation of Chemistry E I, in which the consideration of the various subjects is concluded.

142. Inorganic Chemistry.

PREPARATION: 10, 20.

The fundamental principles of the science are taught in connection with the descriptive chemistry of the non-metallic elements. The lectures are designed to precede the work of the laboratory, in which the students are expected to verify and illustrate the principles and facts which have been discussed in the lecture room. Careful manipulation, thoroughness in observation, accuracy in arriving at conclusions, and neatness in note-taking, are required of each student. The Course lays the necessary foundation for subsequent chemical study.

143. Qualitative Analysis.

PREPARATION: 142.

A practical Course in qualitative analysis for the separation and identification of the common metallic elements and the acids. Each student is also required to made a complete and accurate analysis of various mixtures, alloys and chemicals

used in manufacturing. The laboratory work is supplemented by a course of lectures and conferences, devoted to a general study of the properties of the common metals and their compounds.

144. Quantitative Analysis.

PREPARATION: 142, 143.

A Course in gravimetric and volumetric analysis. Special attention is given to accurate manipulation, the preparation of standard solutions, the calibration of instruments, and to the principles of stochiometry. The laboratory work is supplemented by a course of lectures and conferences.

145. Organic Chemistry.

PREPARATION: 144.

A Course devoted to lectures, conferences and laboratory work on the principles of organic chemistry, as illustrated by the methane and benzene derivatives.

The student is required to prepare, in the laboratory, a number of organic compounds, selected to show the characteristic reactions, and to give training in the practical separation and purification of organic substances. After the synthetic work, the students are given a practical course in organic analysis.

146. Industrial Chemistry.

PREPARATION: 143, 144, 145.

This Course consists of a series of lectures and recitations upon the more important technical chemical processes, including those of Metallurgy. Much attention is given to the general operations common to many industries, such as crushing, grinding, lixiviation, filtration, evaporation, distillation, crystallization, etc., and to the details of various types of apparatus used for carrying on these processes. Some of the more important manufacturing industries, such as the production of alkali, fertilizers, glass, pigments, cement, soap, explosives, paper, as well as wood distillation, the refining of petroleum, etc., are also considered in detail.

146 A. Industrial Chemical Laboratory.

PREPARATION: 146.

A Course in the quantitative study of the preparation and purification of some chemical product, selected as a type of reac-

tion of industrial importance. The processes employed are carefully controlled and the final product is analyzed to determine its purity. When the work is completed, a careful detailed report of the whole process is made and discussed in class.

147. Metallurgy of Iron.

A series of lectures taking up a general consideration of the Metallurgy of Iron and Steel. The introductory part is devoted to a discussion of the physical and chemical properties, and the constitution of cast iron, wrought iron and steel. This is followed by a more extended treatment of the production of cast iron, wrought iron, Bessemer, open-hearth, cement and crucible steel, and of foundry work. In the discussion of the different processes, principles of manufacture are made prominent. The heat treatment of steel and alloy steels is gone into in detail.

148. Technical Analysis.

PREPARATION: 145.

A Course devoted to the following:—

Analysis of gases.

Analysis of oils, mineral and vegetable.

The origin, manufacture, properties, uses and analysis of the various fuels, and the determination of the heat value of fuels by the use of a calorimetric bomb.

149. Theoretical Chemistry.

PREPARATION: 142, 143, 144.

In this Course the more important principles of Theoretical Chemistry are considered; but these are treated with great thoroughness and are illustrated by applying them to a large variety of problems. The principles are further illustrated by lecture experiments. During the Course the following subjects are considered: pressure volume relations of gases and solutions, derivation of molecular and atomic weights, conductivity of solutions, ionic theory and mass action law, effect of temperature on chemical equilibrium, the laws of energy with reference to the production of heat and work, the electro-motive force of voltaic cells and other electro-chemical topics.

160. Dynamical and Structural Geology.

This Course treats of earth movements and the various terrestrial applications of solar energy. The more important geological processes, erosion, sedimentation, deformation and eruption are taken up and discussed.

The latter part of the Course is devoted to lectures on the broader structural features of the earth's crust and the application of the principles of structural geology to practical engineering problems.

161. Lithology.

This Course is a laboratory study of the rock-forming minerals and the more common rocks.

170. German I.

This Course is planned to give the student a knowledge of German grammar, as well as a working vocabulary of scientific terms. During the Course, easy scientific reading is begun.

171. German II.

PREPARATION: 170.

A continuation of German I, in which the student is given full opportunity to extend his vocabulary of technical words, as well as to become familiar with technical books and scientific articles in the current German periodicals.

EQUIPMENT

The School is now housed in the new building of the Association, and has very exceptionally equipped quarters for carrying on the work of the Engineering Courses.

MECHANICAL DEPARTMENT

Mechanical Laboratories

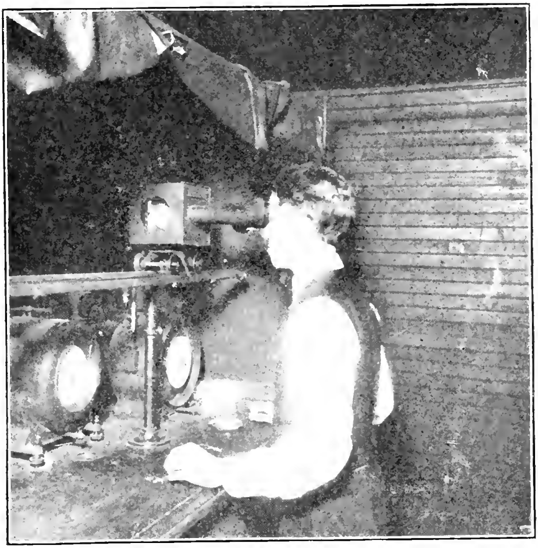
Through the courtesy of the Massachusetts Institute of Technology officials, and also those of the Franklin Union, we are able to avail ourselves of the unexcelled Mechanical Engineering Laboratories of those Institutions for instruction purposes in the laboratory Courses of the Co-Operative School.

In addition to the foregoing facilities, we have several engines of our own for use for instruction, as well as the most modern equipment for gas and fuel analysis.

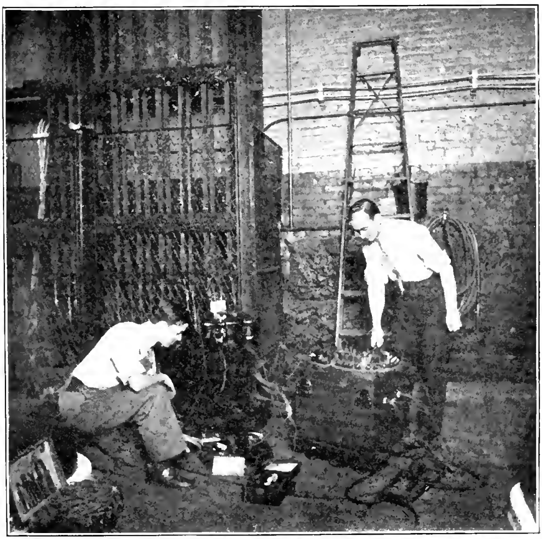
Before the Laboratory Courses commence for the year 1914–1915, our present steam engineering plant will be completely equipped with meters, scales, indicators, and all the necessary accessory equipment for making complete boiler tests, and determining the efficiencies of the various appliances used in generating power, heat, and light for our new building. This will place at the disposal of our classes a perfectly equipped, up-to-date, engineering department, and give them the means of carrying on boiler tests, determining the efficiencies of various fuels and oils, taking indicator diagrams, determining the efficiency of modern reciprocating engines and turbines when direct connected to generators, as well as render them familiar with all the various auxiliary appliances of such a plant, as condensers, pumps, air compressors, etc. The students also have the use of the equipment of our Automobile School, thus giving opportunity to study the most advanced ideas in gasoline engine practice.

MECHANIC ARTS LABORATORIES

There are at present two laboratories, one for metal work and the other for wood working and pattern work, which are available for the use of our students.



DETERMINING THE CANDLE POWER OF GAS
Everett Works
Boston Consolidated Gas Co.



MAKING A HIGH POTENTIAL TEST ON A CONCENTRIC FEEDER
Chatham Street Substation
Edison Electric Illuminating Company

The metal working laboratory is well equipped, and affords the student an opportunity for work with various machines, as: lathes, shapers, drill presses and milling machines. There are also a gas forge and brazing furnace, together with all the required equipment for bench work instruction.

The wood working laboratory has a power band saw, lathes, and all the necessary equipment for wood working and pattern work, and as this catalog goes to press, arrangements are being made for the addition of a Universal circular saw and buzz planer to the present equipment.

In addition to the foregoing, a small, but completely equipped, shop for the construction and repair of apparatus, and for the use of students in connection with their thesis work has been installed. This shop is equipped with a metal and wood working lathe, grinder and all the necessary wood and metal working tools. There is also a very complete set of cabinet worker's tools for use in wood working.

CIVIL ENGINEERING DEPARTMENT

Field Instruments

For work in the field, the Department possesses various surveying instruments, representing the principal makes and types of instruments in general use. The equipment includes transits, levels, compasses, a complete plane table outfit, Locke hand level, flag poles, leveling rods, stadia rod, engineers' and surveyors' chains, steel and cloth tapes and other accessories. For Higher Surveying, an Aneroid Barometer is used for barometic leveling, and the transits are equipped with neutral glasses and reflectors for astronomical observations.

This year a sextant, reading to ten seconds, and equipped with neutral glasses and telescopes, has been added to the equipment.

The scope of the equipment and the fieldwork itself are designed to train the student's judgment as to the relative merits of the various types of field instruments.

Design and Drafting Rooms

The school possesses large, light and well equipped drawing rooms for the carrying on of the designing and drafting, which

form so important a part of civil engineering work. These rooms are supplied with lockers containing the drawing supplies, and files containing blue prints and photographs of structures that represent the best practice. Many of the prints and photographs are of structures erected in and about Boston.

ELECTRICAL ENGINEERING DEPARTMENT

The Electrical Laboratory is well equipped with apparatus for teaching the principles of measurements, and the equipment is being steadily increased and developed for the doing of work of a higher degree of precision. Among the special pieces of apparatus may be mentioned the following: Cary Foster Bridge, a modified form of Hoopes Conductivity Bridge, a Laboratory Wheatstone Bridge, a Leeds Northrup Potentiometer with Volt box, standard cells and low resistance standards, an accurate Chemical Balance and other appliances for the close determination of currents, resistances and potential differences.

There has been added this year, a set of variable inductances, and a set of condensers to the amount of eighty microfarads capacity variable in steps of one tenth microfard each.

Among the instruments for testing purposes, for alternating current work, may be mentioned the following: Three matched voltmeters and three General Electric Type P-3 Iron clad wattmeters arranged for Y connection, six other voltmeters of various ranges, potential transformers, nine ammeters some with current transformers, three integrating meters, one General Electric and one Westinghouse polyphase, switchboard type, integrating wattmeters and a High Torque General Electric test meter. There is also a considerable and increasing assortment of auxiliary testing apparatus, such as synchronism indicators, power factor indicators, frequency indicators, etc.

For direct current testing, there is a large and increasing collection of Weston instruments, both voltmeters and ammeters, of suitable ranges and grades of precision, while the measurement of unusual currents and voltages is ensured by three Weston millivoltmeters with an assortment of standard

shunts and multiplying resistances of various orders of magnitude.

There is also the usual assortment of testing devices, such as speed indicators, tachometers, brakes, loading resistances and the numerous minor pieces of apparatus needed in practical testing and operating of electrical machinery.

Among the machines of this Department, are a pair of specially made, matched machines arranged to run as single phase, two, or three, phase generators, or motors, as well as synchronous transformers, double current generators, or on the Direct Current side as shunt, series, or compound, generators, either two or three wire, or as motors.

There are also a 15 horse power 230-volt Westinghouse motor, a new General Electric 10 horse power Interpole 230-volt motor, a 500-volt generator, two 500-volt series, and several 500-volt shunt motors, and a series parallel controller.

A 45 K. V. A., 60-cycle, single phase, 500-volt generator giving a practically pure sine wave, three General Electric Type H transformers of 5 K. V. A. capacity, a 7½ K. V. A. special General Electric 60-cycle 250-volt alternator, with revolving field tapped for either 1, 2, 3 (star or mesh connection) 6 or 12 phase connection, which may be operated (by the substitution of special rotors) also as a synchronous, or induction motor, or a frequency changer. It is intended, in the near future, to add a duplicate of this machine with another interpole motor to drive it, thus obtaining a matched pair of machines, which, with the transformers, will enable a very wide range of alternating current experimentation to be carried out.

There is also available for advanced instruction, in co-operation with the Mechanical Department, the four three-wire generators (two driven by reciprocating engines and two by Westinghouse-Parsons turbines) in the main generating plant of the Association.

DEPARTMENT OF PHYSICS

There is a large laboratory devoted entirely to Physics together with a lecture room.

This year the Physics Department has been very completely equipped with all necessary apparatus for the experimental

work that is required of the students, as well as that required for lecture demonstration. Among other things, have been added: verniers, levels, spherometers, calorimeters, thermometers, pyrometers, a spectroscope, a miscroscope, a spectrometer, balances, standard gram weight, lecture table galvanometer, optical disk with all accessories, lenses, photometer, a full set of Weather Bureau apparatus including a barograph, thermograph, hygrometer, barometer, maximum and minimum thermometers, etc. These, in addition to the equipment already owned, give a wide range to the experimental work that can be done.

In addition to the foregoing we are preparing to add a large number of new pieces of apparatus, for work in mechanics, heat, and light, and at the time of going to press are getting out specifications so that they may be built for use next year.

DEPARTMENT OF CHEMISTRY

This Department is completely equipped in all respects for carrying on all lines of Chemical work, from that of a High School to that of most advanced College grade. The three laboratories, with accommodations for over one hundred and fifty students, are very exceptionally furnished with all the necessary appliances for chemical work. Some of these are: hoods, drying closets, still, steam and hot water baths, electrolytic circuits, vacuum and pressure apparatus, balances, combustion furnaces, complete sets of apparatus for the sampling and analysis of flue gases and fuels. There are also testing machines for oils, viscosimeters, and different sorts of flash point apparatus. A chemical museum is connected with this Department where are kept specimens for purposes of illustration.

LIBRARIES

There is in connection with the School a professional library containing books pertaining to both the school work of the boys and to their practical work. In addition to this there also are current periodicals on engineering and scientific subjects for their exclusive use. All members of the School are entitled to take books from the Boston Public Library,

and this offers a very unusual opportunity to our non-resident students,

DEPARTMENT OF PHYSICAL TRAINING

Our new gymnasium with all the latest modern equipment gives ample accommodation for all students.

There is a running track on the grounds adjoining, together with tennis and hand ball courts; also a large natatorium where swimming is taught by competent instructors.

In connection with this Department, there are also six excellent bowling alleys, which may be used by the students upon the payment of a nominal fee.

For all further information, write

Mr. Frank Palmer Speare, *Director of Education*,
316 Huntington Avenue,
Boston, Mass.

THE CO-OPERATIVE ENGINEERING SCHOOL

Boston Young Men's Christian Association

Boston, Mass. 19

To the Dean:

I, ... , *hereby respectfully apply for admission to the* . . . . *Engineering Course of the Co-Operative Engineering School for the school year* 19 – 19 , *and submit the following statement:*

Name in full . . . . *Age* . . . .

Residence . . . . *St.* . . . . *City, or Town*

State . . . . *Tel.* . . . .

Parent's (father's) name . . . .

" " *address* . . . .

Graduate of . . . . *Grammar School* . . . .

Graduate of . . . . *High School. Year* . . . .

If not a graduate, how many years were you in High School? . . . .

When did you leave? . . . .

Why did you leave? . . . .

Name of principal . . . .

If employed since graduation, what is name of employer? . . . .

. . . .

Employer's address . . . .

Names and address of two other persons to whom we may direct inquiries concerning you . . . .

. . . .

. . . .

. . . .

Do you plan to complete the full four years' course? . . . .

When do you desire to start work? . . . .

With what firm would you prefer employment? . . . .

THE CO-OPERATIVE ENGINEERING SCHOOL

CATALOG
1915-1916

PUBLISHED BY THE
EDUCATIONAL DEPARTMENT
OF THE
BOSTON YOUNG MEN'S CHRISTIAN ASSOCIATION
316 HUNTINGTON AVENUE
BOSTON, MASS.

CATALOG

OF THE

CO-OPERATIVE ENGINEERING SCHOOL

BOSTON

1915-1916

CATALOG

OF THE

INSTRUCTING STAFF

TOGETHER WITH

A Statement of the Requirements for Admission

AND

A Description of the Courses of Instruction

YEARLY CALENDAR

1915

JANUARY

S	M	T	W	T	F	S
					1	**2**
3	**4**	**5**	**6**	**7**	**8**	**9**
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	**25**	**26**	**27**	**28**	**29**	**30**
31						

FEBRUARY

S	M	T	W	T	F	S
	1	**2**	**3**	**4**	**5**	**6**
7	8	9	10	11	12	13
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21	*22*	**23**	**24**	**25**	**26**	**27**
28						

MARCH

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	1	**2**	**3**	**4**	**5**	**6**
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28	**29**	**30**	**31**			

APRIL

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MAY

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30	*31*					

JUNE

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20	*21*	*22*	*23*	*24*	*25*	*26*
27	*28*	*29*	*30*			

JULY

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				1	*2*	*3*
4	*5*	*6*	*7*	*8*	*9*	*10*
11	*12*	*13*	*14*	*15*	*16*	*17*
18	*19*	*20*	*21*	*22*	*23*	*24*
25	*26*	*27*	*28*	*29*	*30*	*31*

AUGUST

S	M	T	W	T	F	S
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15	*16*	*17*	*18*	*19*	*20*	*21*
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29	*30*	*31*				

SEPTEMBER

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OCTOBER

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31						

NOVEMBER

S	M	T	W	T	F	S
	1	**2**	**3**	**4**	**5**	**6**
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DECEMBER

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26	*27*	**28**	**29**	**30**	**31**	

1916

JANUARY

S	M	T	W	T	F	S
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2	**3**	**4**	**5**	**6**	**7**	**8**
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30	**31**					

FEBRUARY

S	M	T	W	T	F	S
		1	**2**	**3**	**4**	**5**
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13	14	15	16	17	18	19
20	**21**	*22*	**23**	**24**	**25**	**26**
27	**28**	**29**				

MARCH

S	M	T	W	T	F	S
			1	**2**	**3**	**4**
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12	13	14	15	16	17	18
19	**20**	**21**	**22**	**23**	**24**	**25**
26	**27**	**28**	**29**	**30**	**31**	

APRIL

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
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23	**24**	**25**	**26**	**27**	**28**	**29**
30						

MAY

S	M	T	W	T	F	S
	1	2	3	4	5	6
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14	**15**	**16**	**17**	**18**	**19**	**20**
21	**22**	**23**	**24**	**25**	**26**	**27**
28	*29*	*30*	*31*			

JUNE

S	M	T	W	T	F	S
				1	2	3
4	**5**	**6**	**7**	**8**	**9**	**10**
11	*12*	*13*	*14*	*15*	*16*	*17*
18	*19*	*20*	*21*	*22*	*23*	*24*
25	*26*	*27*	*28*	*29*	*30*	

JULY

S	M	T	W	T	F	S
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2	*3*	*4*	*5*	*6*	*7*	*8*
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16	*17*	*18*	*19*	*20*	*21*	*22*
23	*24*	*25*	*26*	*27*	*28*	*29*
30	*31*					

AUGUST

S	M	T	W	T	F	S
		1	*2*	*3*	*4*	*5*
6	*7*	*8*	*9*	*10*	*11*	*12*
13	*14*	*15*	*16*	*17*	*18*	*19*
20	*21*	*22*	*23*	*24*	*25*	*26*
27	*28*	*29*	*30*	*31*		

SEPTEMBER

S	M	T	W	T	F	S
					1	*2*
3	*4*	*5*	*6*	*7*	*8*	*9*
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	**25**	**26**	**27**	**28**	**29**	**30**

OCTOBER

S	M	T	W	T	F	S
1	**2**	**3**	**4**	**5**	**6**	**7**
8	9	10	11	*12*	13	14
15	16	17	18	19	20	21
22	**23**	**24**	**25**	**26**	**27**	**28**
29	**30**	**31**				

NOVEMBER

S	M	T	W	T	F	S
			1	**2**	**3**	**4**
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19	**20**	**21**	**22**	**23**	**24**	**25**
26	**27**	**28**	**29**	*30*		

DECEMBER

S	M	T	W	T	F	S
					1	**2**
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	*18*	*19*	*20*	*21*	*22*	*23*
24	*25*	*26*	**27**	**28**	**29**	**30**
31						

School periods for Division A indicated by type thus: 1 2 3.
School periods for Division B indicated by type thus: **1 2 3.**
Periods when School is not in session indicated by type thus: *1 2 3.*

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CALENDAR

1915

January 18, Monday
Second Term begins for Division A

February 1, Monday
Second Term begins for Division B

February 22, Monday
Washington's Birthday (School exercises omitted)

April 19, Monday
Patriots' Day (School exercises omitted)

May 31, Monday
Decoration Day Celebration (School exercises omitted)

June 1-12, inclusive
Final Examinations

June 8, Tuesday
Graduation

June 10-11, Thursday and Friday
First Entrance Examinations of Co-Operative Engineering School

June 14-September 11
Summer Vacation

July
Practical work for First Division commences

September
Practical work for Second Division commences

September 8-9, Wednesday and Thursday
Second Entrance Examinations of Co-Operative Engineering School

September 13, Monday
First Term of the school year for Division A commences

September 27, Monday
First Term of the school year for Division B commences

October 12, Tuesday
Columbus Day (School exercises omitted)

November 25, Thursday
Thanksgiving Day (School exercises omitted)

December 20-27, inclusive
Christmas Recess (School exercises omitted)

CALENDAR

1916

January 17, Monday
Second Term begins for Division A

January 31, Monday
Second Term begins for Division B

February 22, Tuesday
Washington's Birthday (School exercises omitted)

April 19, Wednesday
Patriots' Day (School exercises omitted)

May 29 to June 10, inclusive
Final Examinations

May 30, Tuesday
Decoration Day (School exercises omitted)

June 6, Tuesday
Graduation

June 8-9, Thursday and Friday
First Entrance Examinations of Co-Operative Engineering School

June 12-September 9
Summer Vacation

July
Practical work for First Division commences

September
Practical work for Second Division commences

September 6-7, Wednesday and Thursday
Second Entrance Examinations of Co-Operative Engineering School

September 11, Monday
First Term of school year for Division A commences

September 25, Monday
First Term of school year for Division B commences

October 12, Thursday
Columbus Day (School exercises omitted)

November 30, Thursday
Thanksgiving Day (School exercises omitted)

December 18-26, inclusive
Christmas Recess (School exercises omitted)

OFFICERS OF ADMINISTRATION

General Administrative Officers

ARTHUR S. JOHNSON, *President*
JACOB P. BATES, *Vice-President*
HAROLD PEABODY, *Recording Secretary*
LEWIS A. CROSSETT, *Treasurer*:
GEORGE W. MEHAFFEY, *General Secretary*

Educational Committee

WILLIAM E. MURDOCK, *Chairman*
ALBERT H. CURTIS
MORGAN L. COOLEY
GEORGE H. MARTIN

Educational Administrative Officers

FRANK P. SPEARE, *Director of Education*
GALEN D. LIGHT, *Asst. Director of Educ. and Bursar*
H. W. GEROMANOS, *Supt. of Engineering School System*
IRA A. FLINNER, *Supt. of Secondary School System*
CHARLES B. GRAY, *Secretary*
ERNEST H. BROOKE, *Registrar*

ADVISERS

The following gentlemen are acting in an advisory capacity on the more important executive matters of the school where their service is of greatest value to us:

Dr. Richard Maclaurin, President of Massachusetts Institute of Technology.
Charles A. Prosser, Secretary of National Commission on Industrial Education.
James P. Munroe, Secretary of Massachusetts Institute of Technology Corporation.
William McKay, General Manager, New England Gas & Coke Co.
Paul Winsor, Chief Engineer, Boston Elevated Railway Company.

OFFICERS OF INSTRUCTION.

H. W. GEROMANOS, S.B., Mass. Inst. Tech.
DEAN

CARL S. ELL, S.B., M.S., Mass. Inst. Tech.
ASSISTANT DEAN

J. A. COOLIDGE, S.B.
Mathematics and Physics

LOREN N. DOWNS, Jr., S.B.
Electrical Engineering

D. V. DRISCOLL
Chemistry

CARL S. ELL, S.B., M.S.
Civil Engineering

A. L. GARDNER, S.B.
Mechanical Engineering

H. W. GEROMANOS, S.B.
Chemistry and Metallurgy

JOHN R. LEIGHTON
Civil Engineering

WALTER BADGER, Jr., A.B.
English

JOHN W. HOWARD, S.B.
Surveying

ERVIN KENISON, S.B.
Descriptive Geometry

H. D. PECK, S.B.
Mechanical Engineering

THOMAS E. PENARD, S.B.
Mathematics

M. E. PINKHAM
Mathematics

CHARLES H. RESTALL, B.S.
Topographical Drawing

C. H. SAMPSON, S.B.
Mechanical Drawing

JAMES H. WORMAN, A.M., Ph.D.
Modern Languages.

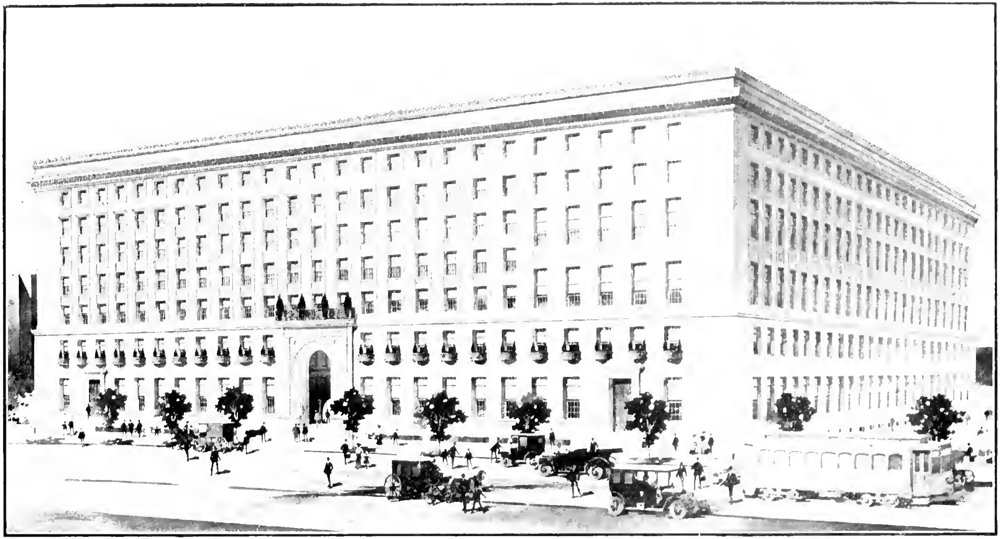
W. LINCOLN SMITH, S.B.
Electrical Engineering

ELLWOOD B. SPEAR, A.B., Ph.D.
Chemistry

E. M. McCRACKEN
Foundry Practice

J. J. HURLEY, M.E.
Power Plant Design

At the time of going to press, our annual election of instructors for the year has not been held, and so it is impossible to publish a complete list of the faculty for 1915-1916.



THE NEW ASSOCIATION BUILDING

This is a picture of the new Association Building which was finished in the Fall of 1913. It contains among other features, school accommodations of the very best, a fine gymnasium, bowling alleys, swimming pool, cafe, dormitories, shops and laboratories, library and reading room, camera club rooms, social and recreative rooms, and auditorium.

GENERAL INFORMATION.

It has generally been conceded that where the practical and the theoretical elements of education can be taught simultaneously, the greatest good is derived by the student, and efforts are being made in all departments of education to accomplish this greatly desired end.

Technical school instruction, depending on class room work and laboratories, must always lack some of the vital characteristics of an actual manufacturing plant, owing to the fact that one is carried on for educational purposes, while the other is operated for dividends. It is this latter fact that gives the Co-operative School idea one great advantage over our usual educational plan. Instead of protecting the student, and training him for several years, for a line of work to which he may later find himself to be entirely unfitted, the Co-operative School at once puts the boy to work in a commercial plant. There he learns life in its vital issues, as well as the problem of getting along with men; thus early finding out whether he has made a wise, or unwise, choice of his life work. This training, too, shows him the use and value of his school work, and finally gives him an unusual opportunity to acquire from actual experience that rare thing, *executive ability*, without which his life probably will always be spent on the lower levels of industry.

That the young men of New England might have an opportunity to attend such a technical school, where both practice and theory are correlated, and at the same time be enabled to defray a large part of the expense of their education by the returns from their practical work, the Co-Operative Engineering School of the Boston Young Men's Christian Association was started in 1909.

This School has now been in operation for six years, and the continually increasing interest in it, as well as its rapid and steady growth, show that it was much needed to fill a place that is filled by no other school in this vicinity.

OBJECT OF THE SCHOOL.

The fundamental aim of this School is to train, for positions in Engineering work, young men who are unable to attend the highest grade technical schools, or colleges. Thus they are enabled to advance farther, and more rapidly, in their chosen work than they could reasonably expect to do without further education than that of a high school course. The training is not in any sense that of a trade school, nor is it exactly that of our best scientific schools, but it stands between the two. The work done is that of a regular engineering school, of high standards, but only the essential subjects are taken, and they, only so far as they will have a direct bearing on the life work of the student. In other words, it is a limited technical training of high grade. The fact that most of our instructors are graduates of, or instructors in, the Massachusetts Institute of Technology, will show the character of work being done.

At present there are four lines of Engineering work being given, and the end sought is to give to students who have already had a high school preparation, or its equivalent, a good training in the fundamental sciences of Mathematics, Chemistry and Physics, and in the important applications of the principles of these sciences to the several branches of engineering. More stress is laid on the development of the ability to apply the acquired knowledge to new engineering problems, than to the memorizing of a multitude of details and very abstract theory, which, while valuable, cannot be gone into too deeply in a course of this type.

The class room instruction is given to small sections, and in the drawing rooms and laboratories, the students receive a great deal of personal attention. The independent solution of assigned problems forms a large part of nearly all courses.

The courses differ from those of many schools, in that a student is not permitted a wide range of subjects from which to choose, in the belief that better results are obtained by prescribing, after the student has selected the line of work for which he desires to prepare himself, the principal studies which he is to pursue.

PLAN OF OPERATION OF THE SCHOOL.

To illustrate the idea of the curriculum at the School, take for instance, the case of a young man "A," who desires to take our Mechanical Engineering Course.

"A" is assigned to one of the plants of a firm that is co-operating with us. Here he is put to work and spends two weeks working for the firm. Then "B," his alternate, who has spent the first two weeks in the School, takes "A's" place with the firm, and "A" puts in the next two weeks at school. Thus the work goes on, the two men exchanging places at the beginning of each two-week period. The studies pursued in the course have a direct practical bearing on the outside work, with the exception of a few courses added, because of the aim which we have, to produce a better citizen, as well as a better employee. The courses given have been decided upon after conference between the co-operating employers and the school authorities, and are the result of the best ideas of both. The subjects are taught in a practical, not in an abstract, or a theoretical way. Thus, in mathematics, instead of teaching algebra, analytic geometry and calculus, as so many separate subjects, they are correlated and taught as instruments for the solution of practical problems arising in engineering work. The aim throughout the course is to give it practical bearing and yet have it complete and thorough in all the needed essentials.

Correlation of Practical and Theoretical Work.

The outside work of the student is as carefully planned as that at the School, and it is progressive. The employers who co-operate with us generally agree, where practicable, to employ the boys in all the different departments of their establishments during their periods of practical duties; this training is just as complete as the school work, and is just as thorough. Where possible, the course of the learner is from the handling of the raw material to the shipment of the finished product. This practical training includes the use of the machines, as well as the executive duties of the plant, so that at the end of his course the graduate may not only know how to do things, but also why they are done in certain ways, and he may, we hope, be of value in improving methods of work.

Co-Operating Firms:

The following firms are co-operating with us at the present time and giving employment to our students:—

Boston Elevated Railway Co.

Boston & Albany Railroad Co.

Boston & Maine Railroad Co.

Mechanical Engineering Department.

Civil Engineering Department.

Boston Consolidated Gas Co.

Aspinwall and Lincoln, Civil Engineers.

New York, New Haven & Hartford Railroad Co.

Bay State Street Railway Co.

Civil Engineering Department.

Mechanical Engineering Department.

Edison Electric Illuminating Co.

A. D. Little Co., Inc.

Chemical Engineers.

H. F. Bryant, Civil Engineer.

Simplex Electric Heating Co.

Simplex Wire and Cable Co.

Frank E. Sherry, Civil Engineer.

Gray & Davis, Inc.

Electrical Devices for Automobiles.

Whitman & Howard, Civil Engineers.

H. F. Beal, Civil Engineer.

Commonwealth of Massachusetts, Land Court.

R. Evans, Essex County Engineer.

Thus far, we have secured new positions for our students as the growth of the School has demanded. However, to be at all sure of work in his chosen branch of engineering, an applicant should file his application early, as the number of positions in any one line is necessarily limited.

SCHEDULES OF PRACTICAL WORK

Below are typical schedules of practical work that have been prepared for our students by some of the companies which are giving them employment :—

BOSTON ELEVATED RAILWAY CO.

First Year

Six months, pit work in carhouse.
Six months, armature room.

Second Year

Twelve months, machine shop work.

Third Year

Six months, mechanical drafting room.
Six months, power station work.

Fourth Year

Six months, line department.
Six months, electrical engineer's department.

BOSTON & MAINE RAILROAD COMPANY

Six months, air brake shops.
One year, erecting work.
One year, machine shop
One year, engine house repairs.
Six months, drafting room and testing work.

BOSTON CONSOLIDATED GAS CO.

Nine months, data takers.
Three months, office.
Three months, pipe fitter's helpers.
Three months, pump man's helpers.
Three months, blowers and exhausters.
Three months, laboratory.
Three months, boiler room.
Three months, generator house.
Three months, steam fitters.
Three months, machine shop.
Three months, assistant engineers.
Six months, laboratory.
Three months, distribution department.

SIMPLEX WIRE AND CABLE CO.

Six months, Insulating Department.
Six months, Braiding Department.
Six months, Cable Shop.
Six months, Twisting Department.
Six months, Machine Shop Construction Gang.
Six months, Electrical Construction Gang.
One year, Testing Room.

SIMPLEX ELECTRIC HEATING COMPANY.

Machine Department	1 year	
Grinding Department	1 month	
Stock Department	4 months	½ year
Winding Department	½ month	
Enamelling Department	½ month	
Assembling Department	½ year	
Testing Department, First Division	½ year	
Testing Department, Second Division	½ year	
Shipping Department, approximately	2 mos.	½ year
Drafting Department, approximately	4 mos.	
General shop experience	½ year	

The above programmes show what the boys do in their practical work, and the courses of study pursued at the School show what they do along academic lines. It will be seen that there is the greatest possible degree of correlation between theory and practice in the work they take up. The men under whose supervision the boys have been in their outside work, are practically unanimous in approval of our plan, and speak highly of the enthusiasm, earnestness and intelligence the students have shown in the performance of their duties.

Attitude of Co-Operating Firms.

Almost all the concerns which co-operated with us last year took one, or more, additional pairs of our students this year, which in itself is significant of their attitude toward our plan.

Earnings.

For the practical work the student does, he is paid a certain amount per hour at the start, and a definite increase per hour, after completing fixed periods of service. The sum earned is more than enough to pay the tuition and the necessary expenses of schooling, but will not cover the cost of living.

In some cases the boys are paid at a higher rate than is called for by their schedule of pay, but that is a courtesy of the company that gives them employment, and is not in any way to be expected as a regular thing. The co-operating firms may make any salary schedule they desire, so long as it does not fall below that originally agreed upon.

The companies which co-operate with us, agree to pay our students ten (10) cents per hour during their first year of service; twelve (12) cents per hour during the second year; fourteen (14) cents per hour during the third year, and sixteen (16) cents per hour during the fourth year.

Basing the earnings on this scale, the student will earn from five (5) to six (6) dollars per working week, during the first year, and an increase of approximately one (1) dollar per working week, for each succeeding year of the four. As there are about thirty weeks of work per year, the earnings will be from one hundred and fifty dollars, upwards.

Frequently a student is able to earn much more than the regular rate, owing to getting extra pay for overtime work.

A census of our students who were working in January, 1914, gave the following data in regard to earnings:

Minimum weekly wage	$5.00
Maximum weekly wage	12.65
Minimum earnings for January, 1914	9.60
Maximum earnings for January, 1914	31.65
*Minimum earnings for year 1913	150.00
*Maximum earnings for year 1913	375.00

Expenses.

As the earnings of the students average from $150 to $300 a year, while expense for tuition, books, drafting supplies, etc., and membership in the Y. M. C. A. is not over $110, there is a considerable balance for incidentals.

While the School supplies all books, drawing instruments, slide rules, etc., it has been found impracticable to furnish the students with note books, paper, drawing ink, pencils, etc. In consequence of this, the student will have a slight expense, of probably less than two dollars, for paper, pencils, etc.

Relation of the Co-Operative School to High Schools.

This School is peculiarly adapted to the high school graduate who, although financially unable to continue his studies

*Based on a total working period of thirty weeks.

further, still has the ambition and ability to get ahead if given the opportunity. Thus boys, being graduated from high school, can still live at home, but spend their time in fitting themselves for something better in the future.

This year, the School has a student body made up of graduates of the following High Schools:

Abington High School
Amesbury High School
Beverly High School
Boston English High School
Boston High School of Commerce
Boston Latin School
Boston Mechanic Arts High School
Bromfield High School
Chicopee High School
Concord High School
Danvers High School
Dennisport High School
Duxbury High School
Everett High School
Foxboro High School
Framingham High School
Groton High School
Hamilton High School
Hardwick High School
Haverhill High School
Hebron Academy
Holliston High School
Hudson High School
Huntington Preparatory School
Hyde Park High School
Lawrence High School
Lowell High School
Lynn English High School
Malden High School
Marblehead High School
Marlboro High School
Medford High School
Medway High School
Merrimac High School
Milford High School
Needham High School
Norwood High School
Peabody High School
Petersham High School
Portland High School (Me.)
Rindge Technical High School
Sanford High School (Me.)
Salem High School
Saugus High School
Somerville English High School
Tilton Seminary
Tisbury High School
Waltham High School
Westboro High School
Weston High School
West Roxbury High School.
Weymouth High School

Number of Students.

The number of positions at our disposal in any one branch of engineering is necessarily limited, and so the number of students who can work part-time in that line is also limited. In

consequence of this, those students who apply first, will get first consideration in the matter of positions, and those who wish to enter should present their applications as soon as possible.

Those applicants who apply for admission to the School too late to be assigned to practical work, may attend the School every period, or every alternate period, as they may wish, and will be assigned to practical work as soon as an opening occurs.

Outside Interests.

A moderate participation in social and athletic activities is encouraged by the Faculty, although a standard of scholarship is required of the students which is incompatible with excessive devotion to such pursuits.

Four-Year Courses.

Regular four-year courses leading to a diploma, are offered in the following branches of engineering:—

I. Civil Engineering
II. Mechanical Engineering
III. Electrical Engineering
IV. Chemical Engineering

Descriptions of these courses and schedules showing the subjects of instruction included, will be found on succeeding pages.

Summer Schools.

There are day and evening summer preparatory schools, conducted by the Educational Department of the Association, and students having entrance conditions, or requiring further preparation for the entrance examinations, may avail themselves of this opportunity to cover the desired work.

Those of our students, who fail to pass in any of their school work, may be permitted to take up the study in the Summer School conducted by the Institute of Technology, provided of course, that Institution is offering such a course. Those students desiring this privilege should consult the Dean, as special permission must be obtained to attend many of the courses.

Physical Training.

Those students who desire gymnasium instruction may obtain the same by the payment of the gymnasium fee in addition to their tuition. This will entitle the student to exercise with the regular classes, as well as to use the gymnasium at other times. The same condition is true of the Swimming Pool.

Requirements for Admission.

Detailed information in regard to the requirements for admission to the courses of instruction in the School, will be found on succeeding pages. In general, the preparation necessary to enable an applicant to pursue one of the Courses, corresponds with that given by good high schools in their four-years' course.

Application for Admission.

Each applicant for admission to the School is required to fill out an application blank, whereon he states his places of previous education, as well as the names of persons to whom reference may be made in regard to his character and previous training.

A deposit of five (5) dollars is required when the application is filed. Should the applicant be rejected, without being permitted to take the entrance examinations, one-half this fee will be returned to him. Should the application be approved, the fee will be retained to cover the cost of his registration, examinations, etc. This fee is non-returnable.

Upon receipt of the application blank, properly filled out, together with the required deposit, the School at once looks up the applicant's references and high school records. When replies have been received to the various inquiries instituted, the applicant is at once advised as to his eligibility to admission to the School. All applicants must meet the Dean for a personal interview before being finally accepted by the School.

Preliminary Fee and First Tuition Payment.

Should a student wish to be assigned to a position with a co-operating firm before the regular opening of School, he is

required to fill out an attendance card and also an application for membership in the Association. A twenty (20) dollar fee, which is credited as part payment of tuition must be paid before he will be assigned to any position at practical work. Once the student has been assigned to such a position, and has accepted it, this fee is non-returnable.

Before any student shall be allowed to attend classes, or be given supplies, he shall have made a total payment of fifty (50) dollars. This is entirely separate from the application fee of five (5) dollars.

Summing up the foregoing:

When a student applies for admission to the School, he makes a deposit of five dollars, which is not considered as part of the tuition, but is used to cover registration expenses. Of the hundred and ten (110) dollar tuition, twenty (20) dollars must be paid before an applicant will be assigned a position at practical work, and an additional thirty (30) dollars, or in all, fifty dollars must be paid before a student will have books and supplies issued to him, and be allowed to attend classes.

An application blank will be found just inside the back cover of this catalog. Fill it out in ink and mail it, together with the required five (5) dollar deposit, to H. W. Geromanos, Dean, 316 Huntington Ave., Boston, Mass. Make all checks payable to the Boston Young Men's Christian Association.

School Year.

The term begins September 13, 1915, and on succeeding years the school year will commence on the second Monday in September. The school exercises are suspended on legal holidays and for one week at Christmas. The School closes at the end of the second week in June.

Attendance.

Students are expected to attend all exercises in the subjects they are studying, unless excused by the Dean. With the exception of one hour in the middle of the day, exercises are held, and students are, in general, expected to devote themselves to the work of the school between 9 A. M. and 5 P. M. There are no exercises on Saturday after 1 P. M.

CLASS IN SURVEYING FIELD WORK
Making a Stadia Survey of Jamaica Pond

Books and Supplies.

The student is furnished with all books, drawing instruments, slide rules, and general supplies, required for his work. This material is loaned to him during the school year, and must be returned in good condition, on demand, or else paid for.

No pens, pencils, note books, note book paper, etc., are issued to the student, but the cost of these minor supplies should not run much over two dollars per year.

Birth and Educational Certificates.

The passage of the recent law, by the Legislature, in regard to the hours and conditions of labor by minors, makes it necessary that all students under twenty-one years of age, shall obtain Educational Certificates before they can be accepted by co-operating firms. For those students who plan to take the practical work, and who live outside of Boston, it will save time and trouble to bring a certificate of birth, or an Educational Certificate, with you on coming to Boston. The Educational Certificates are obtained, free, upon request, from the Superintendent of Schools in the city or town where the student lives, if he lives in Massachusetts. For students living in other states, a certificate of birth, or its equivalent, is all that will be necessary.

Status of Students.

The ability of students to continue their courses is determined in part by means of examinations; but regularity of attendance and faithfulness to daily duties are considered equally essential.

Any student failing to make a satisfactory record either in school, or practical work, may be removed from his position in practical work, or from the School.

Examinations.

Examinations in all subjects are held at the close of each school year, in May and June, and cover the work done during the year. All students who maintain a year's average of 80 per

cent., or over, in their daily work and informal examinations, in any subject, may be excused from the final examination in that subject, at the discretion of the instructor in charge, and with the approval of the Dean. When a final examination is taken, the year's rating in the subject is based half on the examination and half on the record of the year's work.

Students will not be admitted to professional work in the several courses without satisfactory records in those previous subjects on which this work especially depends. That is, for illustration, a student cannot take Advanced Surveying until he has completed Elementary Surveying with a clear record.

Exceptions to this rule may be made in individual cases, after special consideration by the instructor in charge and the Dean.

Reports of Standing.

Informal reports in all subjects are sent every two months, and formal reports covering the year's work are sent at the close of each year. These reports are sent to students, and to the parents, or guardians, of the students. Notification will be made to parents, or guardians, in all cases of students advised, or required, to withdraw, or placed on probation.

Owing to the short school year, it is of vital importance to the student that he get a clear record in all his work each week, and where a student fails to pass in any subject, a notification is sent to his parents, or guardian, to that effect, at the close of the week in which the failure was recorded, so that we may have the home influence exerted to bring his work up to a higher rating the next week.

Every effort is made to keep the student up in his studies, and parents and students are always gladly welcomed by the Dean for conference upon such questions.

Conduct.

It is assumed that students come to the School for a serious purpose, and that they will cheerfully conform to such regulations as may from time to time be made. In case of injury to any building, or to any of the furniture, apparatus, or other

property of the School, the damage will be charged to the student, or students, known to be immediately concerned; but, if the persons who caused the damage are unknown, the cost of repairing the same may be assessed equally upon all the students of the School.

Students are expected to behave with decorum, to obey the regulations of the School, and to pay due respect to its officers. Conduct inconsistent with the general good order of the School, or persistent neglect of work, if repeated after admonition, may be followed by dismissal, or, in case the offence be a less serious one, the student may be placed upon probation. The student so placed upon probation may be dismissed if guilty of any further offense.

It is the aim so to administer the discipline of the School as to maintain a high standard of integrity and a scrupulous regard for truth. The attempt of any student to present, as his own, any work which he has not performed, or to pass any examination by improper means, is regarded as a most serious offense, and renders the offender liable to immediate expulsion. The aiding and abetting of a student in any dishonesty is also held to be a grave breach of discipline.

REQUIREMENTS FOR GRADUATION.

To receive the diploma of the School, the student must have attended the School not less than two years, which must be those immediately preceding his graduation, except as postponement may be specially permitted. He must have completed the prescribed studies of the four years, and must, also, pass final examinations, if required, on subjects pertaining especially to his Course. In addition to this, he must have completed his period of practical work to the satisfaction of his employer.

The student must, also, prepare a thesis on some subject included in his course of study; or an account of some research made by him; or an original report upon some machine, work of engineering, or industrial plant. This thesis, or design, must be approved by the Dean. Theses are to be written on one side only of paper of good quality, 8 x 10 1-2 inches in size, with an

inch margin on each side. Theses must be handed to the Dean not later than the day on which the first annual examination occurs.

All theses, and records of work done in preparation of theses, are the permanent property of the School.

The diploma of the School represents not only the formal completion of the subjects in the selected course of study, but also the attainment of a satisfactory standard of general efficiency. Any student, who does not show in the fourth-year work of his Course, that he has attained such a standard, may be required, before receiving the diploma, to take such additional work as shall test his ability to reach that standard.

No diploma can be given until all dues to the School are discharged.

The diplomas awarded graduates will be signed by both the School authorities and the employers.

Students completing the school course without being engaged in any practical work, will receive a special diploma.

Tuition Fees.

A fee of five (5) dollars is to be paid when the application is filed, as a matriculation fee. This fee is non-returnable, if the applicant is permitted to take the entrance examinations. If he is rejected, without taking the examinations, one-half the deposit will be returned.

The tuition fee is $110 per year, and must be paid by entering students as follows:

Twenty dollars preliminary fee (see previous page).

Thirty dollars additional, before receiving any supplies.

or,

Fifty dollars on, or before, attending classes and receiving supplies.

Thirty dollars December 1.

Thirty dollars March 1.

One-half the year's tuition will be charged any student who attends the School during six school weeks.

Upper class students whose tuition rate is $110 shall pay it as follows:

Forty dollars at beginning of fall term.

Thirty dollars December 1

Thirty dollars February 1

Ten dollars April 1

Students who were enrolled in the School, when the tuition was increased from $100 to $110 per year, will be allowed to complete their course at the same rate of tuition that existed at the time of their entrance.

Such students shall pay their tuition as follows:

Thirty dollars at beginning of fall term.

Thirty dollars December 1

Thirty dollars February 1

Ten dollars April 1

Failure to make the required payments on time, renders the student liable to be barred from his classes, until the matter has been adjusted with the Bursar.

This tuition fee includes membership in the Association, as well as the use of all books, drawing supplies, etc., which are required in the school work. Such supplies as are required by the student for his school work, are loaned to him by the School, and must be returned on demand, in good condition, or else paid for.

Refunds.

Students who are compelled, for any reason, to leave the School before the end of the school year, shall be charged at the rate of seven and one-half dollars per week for each week of school attendance, and in addition to this, shall be charged an extra twenty dollars over and above this weekly rate. The date of withdrawal of any student shall be the day on which the School receives formal notice of his intentions to leave, at which time also all his supplies shall be returned, or paid for. No application for refunds will be considered until the student's supplies have all been returned, or paid for.

Increase of Tuition.

The tuition of all students entering the School, on and after January 1, 1916, will be $125 per year.

Those students, who are already members of the School at that time, will be allowed to complete their course at the same rate of tuition that existed at the time of their entrance.

Payments.

All payments should be made to Galen D. Light, Bursar.

Make checks payable to Boston Young Men's Christian Association.

Residence.

For those students who will not be living at home, there are excellent accommodations, at very moderate rates, in the dormitories that are in our new building. These rooms may be had separately, or in groups with a common reception room, and the price varies from $1.50, or $2.00 per week, upwards. As board costs from $3.50 to $5.00 a week, a student could get room and board for from $5.00 a week to $6.00 per week.

Location.

The buildings are located on Huntington Avenue, just beyond Massachusetts Avenue, and are within easy access to the various railroad stations, and the business and residental sections, by electric cars.

Special Students.

It is possible for students to enter the School and spend either every period at school, or else every other period at school, without being placed in practical employment. There is no extra charge under these conditions.

A student obtaining a low rating on his entrance examinations, or who may not be eligible to assignment to practical work, for other reasons, may, by special permission, be allowed to attend school either every period or every alternate period, and, if his record for the year justifies it, may be assigned to practical work the following year.

Three-year Course.

It has been found possible for students to attend school every week and to complete the course in three years. To do this, the student must have had a good high school education and cannot do the practical work in connection with the course.

Socials.

In order to provide for the social intercourse of the students, as well as to enable the men in the different divisions to meet one another, socials and entertainments are held monthly for their exclusive enjoyment. An out-door field meet is also held yearly, at the close of the school year, at which time various interclass competitive games are enjoyed.

Vacations.

The employers may allow our students one week vacation at Christmas, and two weeks vacation during the summer. They are not paid for this time. Whether a student shall have a full week at Christmas, or not, is at the option of the employer.

Summer Employment.

When a student, for good reason, is unable to continue his practical work during the summer, while the School is not in session, it is sometimes possible to get him leave of absence for the summer so that he can return to his employer in the fall. All special arrangements for the summer work must be referred to the Dean.

Probation Period.

When, for any reason, it is deemed advisable, the School reserves the right to place any entering student upon a period of probation, extending from one to three months, before placing him at practical work. Whether he shall be placed at work at the end of this time, will be determined by the character of the work that he has accomplished during this probationary period.

POST-GRADUATE OPPORTUNITIES.

Students of good ability on completing the Co-operative Engineering Course, have the opportunity to attend the Massachusetts Institute of Technology, if they care to, and by taking special extra work in the Co-Operative School during their course, they may reasonably expect to complete the Technology work and get their degree in two years. Through conference with the officials of the Institute, it has been found that those of our courses equivalent to theirs will probably be accepted in place of theirs, and the student given a clear record in such subjects, either by passing examinations, or at the discretion of the head of the Department. Since a large number of our courses are covering the same ground as those at the Institute, a capable student should be able at the end of his course to get a clear rating at Technology equivalent to at least two years' work there. This offers a rare opportunity for an ambitious, capable young man to get the most valuable kind of an education at small cost.

For further information about the School, write to

H. W. Geromanos, Dean,
316 Huntington Avenue,
Boston, Mass.

REQUIREMENTS FOR ADMISSION.

In general, the preparation necessary to enable an applicant to pursue successfully one of the regular courses, corresponds with that afforded by high schools of the better grade, offering a four-year course of study.

Experience has shown that students who have not a complete high school course, or its equivalent, are severely handicapped in their work, so that such previous training is regarded as just as essential for entrance as the satisfactory passing of the required examinations.

In very exceptional cases a student who is not a high school graduate, may be allowed to enter as a special student, but only after his case has been passed on favorably by the Faculty and the Dean.

Every applicant must furnish references as to his character and ability, and must show cause why he may reasonably be expected to make a success of his course, both in the practical work and at the School. He must be willing and able to work hard, both mentally and physically.

For those unable to carry on the Engineering Courses owing to inadequate preliminary training, it has been found possible to plan special courses, of one, or two years' duration, in the Preparatory School to fit for the Engineering School.

All applicants planning to take the examinations, shall notify the Dean not less than ten days previous to the date of the examinations. For those students who may not be prepared to take the examinations in June, but who desire to work during the summer and then take the examinations in the Fall, arrangements may be made by consultation with the Dean.

Any subjects not passed in the June examinations may be passed at the September examinations.

Applicants for admission to the Co-Operative Engineering School are, in general, required to pass the entrance examina-

tions of the School. Certificates of entrance examinations passed for admission to colleges or technical schools of good standing, may be accepted in lieu of examinations.

The last page of this catalog is in the form of an application blank. It should be filled out in ink and forwarded, with the required five dollar deposit, to H. W. Geromanos, Dean, 316 Huntington Ave., Boston, Mass. Make all checks payable to The Boston Young Men's Christian Association.

ADMISSION TO THE FIRST YEAR.

The student intending to enter the School should bear in mind that the broader his intellectual training in any direction, and the more extensive his general acquirements, the greater will be the advantages he may expect to gain. The importance of thorough preparation in the subjects set for examination also is great, for the character and the amount of instruction given in the School from the outset, leave little opportunity for one, imperfectly fitted, to make up deficiencies, and render it impossible for him to derive the full benefit from his course, or perhaps even to maintain his standing. The training given in the best high schools will, in general, afford suitable preparation.

The requirements of age and scholarship specified are regarded as a minimum in all ordinary cases, and only exceptional circumstances will justify any relaxation. Parents and guardians are advised that it is generally for the ultimate advantage of the student not to enter under the age of eighteen years.

ENTRANCE EXAMINATIONS IN BOSTON.

Examinations for admission to the first year class will be held at 316 Huntington Avenue on June 10 and 11, and on September 8 and 9, 1915.

Students are advised to attend the June Examinations, if possible, in order that any deficiencies then existing may be made up in September, before entrance.

Examination Fees.

Before taking the examination, the applicant must have filed his application, together with the required five dollar de-

posit. If he gets a clear record in his examinations, he may pay the fifty (50) dollar first payment of his tuition fee, at any time before school opens. If, however, he wishes to start practical work, he must pay the preliminary fee of twenty dollars before being assigned to a position.

Order of Examinations.

Thursday, June 10, 1915.

10.00 A. M. to 12.00 N. .... Algebra
1.00 P. M. to 3.00 P. M. .... Plane Geometry

Friday, June 11, 1915.

10.00 A. M. to 12.00 N. .... English
1.00 P. M. to 3.00 P. M. .... Physics

No fees are to be paid at this time.

SUBJECTS FOR EXAMINATION.

To be admitted as a student to the first-year class, the applicant must have attained the age of seventeen years, and must have passed satisfactory examinations in the following subjects:—

Elementary Algebra.

Plane Geometry.

English.

Elementary Physics.

The examination in Physics is not required, but students not receiving a clear record in it, by examination or otherwise, will be requred to take a special course in Physics, in addition to their regular first-year work.

The detailed requirements in the various subjects are as follows:—

Plane Geometry.

The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas, regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

Algebra.

The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one, or more, unknown quantities; problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative.

English.

The examination in English will be as far as possible a test of the candidate's ability to express himself in writing in a manner at once clear and accurate.

The candidate will be required to write upon subjects familiar to him. His composition should be correct in spelling, punctuation, grammar, idiom and formation of paragraphs, and should be plain and natural in style. He will be judged by how well, rather than by how much he writes.

Physics.

The candidate will be expected to be familiar with the fundamental principles of Physics. It is especially desirable that he should have a good knowledge of general mechanics and of the mechanics of solids, liquids and gases. A knowledge of physical hypotheses is comparatively unimportant. Text-book instruction should be supplemented by lecture-room experiments. A sufficiently extended treatment of the subject will be found in any of the principal text-books now in use in secondary schools. Ability to solve simple problems will be expected.

Students presenting laboratory note books in Physics, properly endorsed, will be allowed 20 per cent. on the examination rating for such books as are accepted. That is, an accepted note book adds 20 per cent. to whatever rating is obtained on the written examination up to 100 per cent.

Arithmetic.

The requirement in Arithmetic for entrance has been waived.

Admission by Certificates.

Students presenting certificates from a preparatory school, which has the certification privilege, in any, or all, subjects required for entrance, may be given credit in those subjects, without an examination, upon application to the Dean. Such applications, together with a certificate from the principal, or instructor, stating the work done and the ranks received, shall be filed with the Dean, not less than ten days preceding the examination date.

The right is reserved to require any applicant to take the Entrance Examinations, without regard to such certification, should it be deemed necessary.

Conditions.

A candidate failing in only one, or two, of the examination subjects, may be admitted with "conditions." A candidate incurring conditions in June must repeat, in September, examinations in those subjects in which he has failed.

In any case of a condition existing after a second examination in a subject, special arrangements must be made with the Dean, before a student will be allowed to attend classes.

Modern Languages.

There is no requirement in the modern languages for entrance to the School, and students who desire to take up these subjects during their course, may do so, provided they show the capacity to handle such work in addition to the required subjects.

OUTLINES OF SUBJECTS REQUIRED FOR ENTRANCE.

By writing the Dean, prospective applicants may receive a brief outline covering the subjects in Physics and Algebra upon which the Entrance Examinations are based. These outlines are issued in order that the applicant may concentrate his study upon subjects that are essential to the work, and not spread his efforts over too large a field.

MAKING A HIGH POTENTAL TEST ON A CONCENTRIC FEEDER
Chatham Street Substation
Edison Electric Illuminating Company

IN THE RESEARCH LABORATORY
A. D. Little Co., Inc., Engineering Chemists
Hydrolyzing Wood Fiber into Alcohol

COURSES OF STUDY.

General Information.

The schedules of the various courses are given on the following pages. The first year work of all courses is practically the same, with a few exceptions, which are made because of the need of the student for elementary training in his professional subjects. This is done so that he may gain more from his early practical work, as well as be of more use to his employer by reason of a better understanding of the duties he may be called upon to perform.

The school year comprises eighteen weeks of class work, and one week of examinations for each division, so by dividing the total hours of class work by eighteen, the number of hours per week in any subject may be readily determined. For example, if mathematics comes ninety hours per year, it will be given five hours per week. Some subjects are given double time, but only extend through half the year. The student is expected to spend from one to two hours in preparation, for every hour given over to class work, in all subjects except Drawing.

The number in parenthesis, following the subject in the "Outlines of Courses," is the number by which that subject is identified in the descriptive matter under "Subjects of Instruction."

The work is so planned that the student will be required to spend from 50 to 60 hours, in preparation and class work, during each school week.

When a student elects a Course, he is required to complete all subjects in that Course, not indicated as "Optional," in order to receive a diploma. No subject is to be dropped, or omitted, without the consent of the Dean.

CIVIL ENGINEERING.

The purpose of this Course is to give the student a broad education in those subjects which form the basis of all branches of technical education, and a special training in those subjects comprised under the term "Civil Engineering." It is designed to give the student sound training, both theoretical and practical, in the sciences upon which professional practice is based.

Civil Engineering covers such a broad field that no one can become expert in its whole extent. It includes Topographical Engineering, Municipal Engineering, Railroad Engineering, Structural Engineering, and Hydraulic and Sanitary Engineering. It covers land surveying, the building of railroads, harbors, docks and similar structures; the construction of sewers, water works, roads and streets; the design and construction of girders, roofs, trusses, bridges, buildings, walls, foundations and all fixed structures. All of these branches of Engineering rest, however, upon a relatively compact body of principles, and in these principles the students are trained by practice in the class-room, drawing room, the field and the testing laboratory.

The course is designed to prepare the young engineer to take up the work of assisting in the design and construction of structures; to aid in the location and construction of steam and electric railways, sewerage and water supply systems; and to undertake intelligently, supervision of work in the allied fields of mining, architectural, and electrical engineering and general contracting.

COURSES OF STUDY

I. Civil Engineering.

First Year	Hours of Exercise
Mathematics I (10)	90
Physics I, Lectures and Recitations (20)	72
Physics I, Laboratory (21)	36
Elements of Electricity (126)	36
Descriptive Geometry I (42)	72
Mechanical Drawing (40)	72
Engineering Computations (14)	36
English I (1)	54
Surveying I (50)	36
Surveying I, Fieldwork and Plotting (53)	108
Second Year	
Surveying II (52)	36
Surveying II, Fieldwork and Plotting (53)	108
Topographical Drawing (54)	36
Applied Mechanics I (30)	54
Physics II, Lectures and Recitations (22)	54
Physics II, Laboratory (23)	36
Mathematics II (11)	72
Precision of Measurements (13)	9
English II (2)	36
Descriptive Geometry II (43)	36
Mechanism (90)	27
Practical Electricity I, Lectures and Recitations (134)	36
Practical Electricity I, Laboratory (135)	36
Third Year	
Railroad Engineering (57)	54
Railroad Engineering, Fieldwork and Drawing (58)	108
Theory of Structures (70)	30
Structural Drawing (73)	36
Highway Engineering (56)	18
Materials (81)	36
Applied Mechanics II (31)	60
Hydraulics (110)	54
Practical Electricity II, Lectures and Recitations (136)	36
Practical Electricity II, Laboratory (137)	36
General Metallurgy (147)	18
Dynamical and Structural Geology (160)	54
Fourth Year	
Structural Design (74)	108
Theory of Structures, Bridges and Similar Structures (71)	90
Advanced Structures (72)	36
Concrete Construction (80)	36
*Concrete Design (80A)	54
Foundations (82)	18
Testing Materials Laboratory (34)	12
Hydraulic and Sanitary Engineering (112)	36
Engineering Laboratory (97)	36
Practical Electricity II, Lectures and Recitations (136)	36
Practical Electricity II, Laboratory (137)	36
Heat Engineering, Thermodynamics (95)	54
Hydraulic Motors (Optional) (111)	36
Thesis	108

* Omitted in 1915-1916.

MECHANICAL ENGINEERING.

This Course is designed to give a broad foundation in those fundamental subjects which form the basis for all professional engineering practice, and to especially equip the young engineer with a thorough knowledge of the various phases of Mechanical Engineering. The Course embraces instruction by text-book, lecture, laboratory and work-shop practice, with special references to the following branches: Steam Engineering, Hydraulic Engineering, Power Plant Design, Machine Design, Applied Electricity, Heat Engineering, and allied fields of the engineering profession.

The Course affords training in the methods, and gives practice in the process of Construction, which develops in the student the capacity for thinking along mechanical lines, thus enabling him to base all of his work upon fundamental principles already learned, rather than upon empirical rules. It is the endeavor to give the student a thorough theoretical training and meanwhile devote sufficient time to the practical work, so that he may become a proficient mechanical engineer both in theory, and in practice, in all of the various branches of Mechanical Engineering previously mentioned.

COURSES OF STUDY

II. Mechanical Engineering.

First Year	Hours of Exercise
Mathematics I (10)	90
Physics I, Lectures and Recitations (20)	72
Physics I, Laboratory (21)	36
Elements of Electricity (126)	36
Descriptive Geometry I (42)	72
Mechanical Drawing (40)	144
Engineering Computations (14)	36
English I (1)	54

Second Year

Mechanism and Valve Gears (90)	72
Mechanical Engineering Drawing (91)	144
Descriptive Geometry II (43)	36
Mathematics II (11)	72
Precision of Measurements (13)	9
Physics II, Lectures and Recitations (22)	54
Physics II, Laboratory (23)	36
Applied Mechanics I (30)	54
Practical Electricity I (134)	36
Practical Electricity I, Laboratory (135)	36
English II (2)	36
Woodworking and Patternworking (102) (Optional)	54
Foundry Practice (99)	9

Third Year

Heat Engineering, Thermodynamics and Boilers (95)	90
Applied Mechanics II (31)	60
Machine Drawing (92)	144
Boiler Design (100)	36
Materials (81)	36
Hydraulics (110)	54
Practical Electricity II, Lectures and Recitations (136)	36
Practical Electricity II, Laboratory (137)	36
General Metallurgy (147)	18
Machine Work (103) (Optional)	54
Forging, Chipping and Filing (101) (Optional)	36

Fourth Year

Machine Design, Statics and Dynamics (93)	180
Applied Mechanics III (33)	30
Testing Materials Laboratory (34)	12
Engineering Laboratory (97)	36
Hydraulic Motors (111)	36
Power Plant Design (96)	54
Concrete Construction (80)	36
Foundations (82)	18
Factory Construction and Management (104)	54
Thesis	108

ELECTRICAL ENGINEERING.

Electrical Engineering having in recent years developed along lines demanding a thorough appreciation of physical theory, as well as a broad working knowledge of Mathematics, it is essential that students planning to take this Course should realize the fundamental necessity of obtaining a solid grounding in these subjects upon which to build.

It is not the purpose of the Course to attempt the impossible aim of turning out fully trained engineers in the various branches of the science, especially as it is becoming daily more and more differentiated and specialized; but rather to lay a broad and thorough foundation for future progress along the lines of work which may particularly appeal to the individual, by giving him a good working acquaintance with the essential principles, which underlie each of the more specialized branches of professional activity. Parallel with the theoretical work, runs a carefully planned course of laboratory work which is intended to develop the student's powers of accurate observation, of planning work and methods for himself, with due regard to saving of time and precision of results. For more detailed matters, the reader is referred to the description of the several courses and subjects of instruction.

COURSES OF STUDY

III. Electrical Engineering.

First Year	Hours of Exercise
Mathematics I (10)	90
Descriptive Geometry I (42)	72
Engineering Computations (14)	36
English I (1)	54
Physics I, Lectures and Recitations (20)	72
Physics I, Laboratory (21)	36
Mechanical Drawing (40)	144
Elements of Electricity (126)	36
Second Year	
Direct Current Machinery (128)	18
Direct Current Practice (129)	18
Electrical Problems (125)	18
Theoretical Electricity (127)	18
Methods of Wiring and National Code (131)	9
Electrical Engineering I, Laboratory and Reports (122A)	90
Mechanism (90)	36
Mathematics II (11)	72
Precision of Measurements (13)	9
Physics II, Lectures and Recitations (22)	54
Physics II, Laboratory (23)	36
Applied Mechanics I (30)	54
Mechanical Engineering Drawing (91)	72
Descriptive Geometry II (43)	36
English II (2)	36
Woodworking and Patternworking (102) (Optional)	54
Third Year	
Alternating Currents, Lectures, Recitations and Problems (138)	45
Alternating Current Machinery, Lectures, Recitations and Problems (139)	63
Technical Electrical Measurements (130)	18
Technical Electrical Measurements, Laboratory and Reports (130 B)	90
Electrical Engineering II, Laboratory and Reports (122 B)	90
Applied Mechanics IIA (31)	45
Heat Engineering, Thermodynamics (95)	54
Machine Drawing (92)	72
Hydraulics (110)	54
Construction and Operation of Intercommunicating Telephones (124) (Optional)	6
Forging, Chipping and Filing (101) (Optional)	36
Fourth Year	
Alternating Current Machinery, Lectures and Recitations (139)	36
Alternating Current Machinery, Laboratory and Reports (139 A)	90
Electrical Transmission of Power (120)	18
Illumination and Photometry (132)	18
Central Stations (121)	18
Electric Railways (133)	27
Studies in Electrical Construction (123)	27
Testing Materials Laboratory (34)	12
Hydraulic Motors (111)	36
General Metallurgy (147)	18
Surveying I A (50 A)	18
Engineering Laboratory (97)	36
Machine Work (Optional) (103)	54
Thesis	144

CHEMICAL ENGINEERING.

During the great industrial advance of recent years, chemical industry has been in the front rank of progress, and perhaps the most potent reason for this may be found in the replacement by scientific guidance, of the old rule of thumb methods.

Again, owing to the keenest competition, manufacturers have been compelled to utilize every product of their plants and this has called for skilled chemical knowledge.

The Course in Chemical Engineering has, for its purpose, the training of students competent to take responsible places in the operation of industries based on chemical principles.

During their course, the students are employed in chemical industries, as gas manufacturing plants, chemical engineering companies, etc., so that they not only get an excellent training in the theory of such work at school, but get a thorough familiarity with the technical side of the industry, as well.

The class work includes a training in Inorganic, Analytical, Organic, and Industrial Chemistry, which is accompanied by appropriate laboratory work.

In addition to the foregoing subjects, the student is given a good knowledge of mechanical and electrical subjects, as Drawing, Applied Mechanics, Direct Current Practice, Technical Electrical Measurements, etc., which are taken up in a way to give them especial bearing on the work of the Course.

COURSES OF STUDY

IV. Chemical Engineering.

First Year	Hours of Exercise
Mathematics I (10)	90
Physics I, Lectures and Recitations (20)	72
Physics I, Laboratory (21)	36
Elements of Electricity (126)	36
Descriptive Geometry I (42)	72
Mechanical Drawing (40)	72
Engineering Computations (14)	36
English I (1)	36
Inorganic Chemistry, Lectures, Laboratory and Recitations (142)	162
German I (170)	36

Second Year

Qualitative Analysis (143)	144
Quantitative Analysis (144)	144
Mathematics II (11)	72
Precision of Measurements (13)	9
Physics II, Lectures and Recitations (22)	54
Physics II, Laboratory (23)	36
Applied Mechanics I (30)	54
Mechanical Engineering Drawing (91)	54
Mechanism (90)	54
English II (2)	36
German II (171)	36

Third Year

Technical Analysis (148)	90
Theoretical Chemistry (149)	72
Theoretical Chemistry, Laboratory (149 A)	36
Organic Chemistry, Lectures (145)	54
Organic Chemistry, Laboratory (145 A)	90
Applied Mechanics II (31)	60
Heat Engineering: Thermodynamics (95)	72
Machine Drawing (92)	72
Practical Electricity I, Lectures and Recitations (134)	36
Practical Electricity I, Laboratory (135)	36
Hydraulics (110)	54

Fourth Year

Industrial Chemistry, Lectures (146)	54
Industrial Chemistry, Laboratory (146 A)	108
Organic Chemistry, Lectures (145)	36
Organic Chemistry, Laboratory (145 A)	90
Chemical Engineering (150)	54
Practical Electricity II, Lectures and Recitations (136)	36
Practical Electricity II, Laboratory (137)	36
Thesis	108

SUBJECTS FOR INSTRUCTION.

Instruction is given by lectures and recitations, and by practical exercises in the field, the laboratories, and the drawing-rooms. A great value is set upon the educational effect of these exercises, and they form the foundation of each of the four Courses. Text-books are used in many subjects, but not in all. In many branches, the instruction given differs widely from available text-books; and, in most of such cases, notes on the lectures and laboratory work are issued, and are furnished to the students. Besides oral examinations in connection with the ordinary exercises, written examinations are held from time to time. At the close of the year, in May and June, general examinations are held.

In the following pages will be found a more or less detailed statement of the scope, as well as the method of instruction, of the subjects offered in the various Courses. The subjects are classified, as far as possible, related studies being arranged in sequence.

The subjects are numbered, or numbered and lettered, for convenience of reference in consulting the various Course Schedules. As the total number of hours per term devoted to a subject sometimes varies in different Courses, these hours are not in every case given in connection with the following descriptions.

The requisites for preparation include not only the subjects specified by number, but also those required as a preparation for them. The reason for this is that to properly carry on the more advanced subjects, the student must have become proficient in all subjects necessary for a clear comprehension of the last subject. Some studies specified as being required in preparation, may be taken simultaneously. The student must complete such subjects before starting on more advanced work.

By careful consideration of the Course Schedules, in connection with the following Description of Subjects, the appli-

cant for a special Course may select, for the earlier part of that Course, such subjects as will enable him to pursue later those more advanced subjects which he may particularly desire.

Applications for exception, for sufficient causes, from the required preparation, as stated in connection with each subject described below, will always be considered by the Dean.

The topics, included in the list which follows, are subject to change at any time by action of the School authorities.

SYNOPSIS OF COURSES.

1. English I.

This is a course in the principles of composition and letter writing. Special attention is given to spelling, punctuation and grammar.
The chief object of the work is to enable the student to write correct, lucid and easy business English.

2. English II.

PREPARATION: 1.

This course is a continuation of English I and is devoted to writing business letters, to descriptions of processes and machinery, and to all other possible means of enabling the student to express himself with accuracy and precision, both orally and in writing.

10. Mathematics I.

PREPARATION: ALGEBRA, GEOMETRY.

Variation, logarithms, slide rule, exponential equations, the uses of formulas in Physics and Engineering.
Trigonometry, including circular measure, co-ordinates, trigonometric ratios, formulas, law of sines, law of cosines, solution of right and oblique triangles and applications to problems in Physics and Engineering.

11. Mathematics II.

PREPARATION: 10.

Co-ordinates, plotting of functions, interpolation, the straight line, curves represented by various equations, graphic solution of equations, determination of laws from the data of experi-

ments. Rate of increase, differentiation, determination of maxima and minima by differentiation, integration, definite integrals, determination of mean value, area and volume by integration, center of gravity, moment of inertia, partial differentiation.

13. Precision of Measurements.

PREPARATION: 10, 11.

This course, which is required of all students in the second half of the second year, comprises a thorough discussion of the fundamentals of the Theory of Measurements, including a study of the Sources of Error, the Best Representative Value of the result of a series of measurements, the determination of the several Precision Measures of the result of one's work, the converse problem of how best to proceed in order to reach a given degree of precision, and a thorough consideration of the proper use of Significant Figures.

14. Engineering Computations.

This course is taken by all first year students and is an unprepared exercise coming two hours per week throughout the first year. The work covers arithmetical computations of the various kinds common to engineering practice, such as addition, subtraction, division and multiplication of whole and mixed numbers, problems in the use of fractions, percentage calculations, square root, etc.

19. Review Mathematics.

This course is given in the first year to those students who have had inadequate mathematical training previous to entering the School. The work covers Algebra and Geometry and aims to strengthen the student on his weak points. Students whose records in Mathematics I are not satisfactory may be required to take this course.

20. Physics I.

The subjects considered are general mechanics, molecular mechanics, wave-motion and optics, which topics are discussed both mathematically and experimentally. It is the purpose of

the course to lay a thorough foundation for subsequent study of experimental, and technical physics. Hence it is planned with immediate reference to familiarizing the pupil with the fundamental principles of the science. The lectures are illustrated by suitable experiments.

21. Physical Laboratory I.

PREPARATION: 20.

A course of experimental exercises in the first year, laid out individually for each student. The experiments are correlated, so far as practical, with the lecture and class-room work, the first year being devoted to experiments in mechanics. The use of the various instruments of precision is taught, as far as may be, in connection with experiments, each of which illustrates some different method, or principle. The experiments relate to the mechanics of solids, liquids, and gases.

22. Physics II.

PREPARATION: 20.

A course of experimental lectures which is a continuation of Physics 1. In this work the student completes the study of physics started in Physics 1.

23. Physical Laboratory II.

PREPARATION: 22.

A series of experiments in the second year, correlated as far as practicable with the lecture course. The experiments in Optics include the use of a compound microscope, the determination of the focal length of lenses, gas photometry, indices of refraction, and elementary spectrum analysis. All work is strictly quantitative, and the attention of the student is especially directed to the precision discussion of his results.

24. Heat Measurements.

PREPARATION: 22.

A course in which is studied the various methods of measuring high temperature by pyrometric methods. The experimental work includes the use of the thermo-electric, calorimetric, and electric resistance, pyrometers together with selected experiments giving instruction in the use of Seger Cones, heat treatment of steel, tempering, etc.

29. Review Physics.

A course covering the essentials of Physics as taught in the best high schools, and designed to help those students who have had insufficient preparation before entering the Engineering School. Students whose records in Physics I are unsatisfactory, may be required to take this course in addition to their other work.

30. Applied Mechanics I.

PREPARATION: 10, 11, 20, 22.

The course comprises a study of the general methods and applications of statics, including the determination of reactions, stresses in frames; of distributed forces, center of gravity; of moment of inertia and radius of gyration of plane areas and solids. Kinematics and dynamics are also included in this course, together with the equations for uniform and varying rectilinear and curvilinear motion, centrifugal force, pendulum, harmonic motion, rotation, combined rotation and translation, momentum and angular momentum, center of percussion, impact, work, power and kinetic energy.

31. Applied Mechanics II.

PREPARATION: 30.

This course comprises a study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to tension, to compression and to shearing; common theory of beams, with thorough discussion of the distribution of stresses, shearing forces, bending moments, slopes and deflections.

A study is also made of the strength of hooks, columns, shafts and springs, and combined stresses in beams subjected to tension and compression, as well as bending. A brief consideration of strains, and the relations of the stresses on different planes in a body and the stresses in simple frames subjected to bending forces, is taken up in the latter part of the course.

32. Applied Mechanics II A.

PREPARATION: 30.

This course comprises a study of the strength of materials, as described in 31, with the exception that the study of strains and

the relations of the stresses on different planes in a body, as well as the stresses in simple frames subjected to bending stresses, are omitted.

33. Applied Mechanics III.

PREPARATION: 31.

A course treating of the laws of friction, including a study of the distribution of friction on shaft journals and pivots; also a study of the transmission of power by belting and by ropes, and of the friction reducing power of lubricating oils.

34. Testing Materials Laboratory.

PREPARATION: 31.

The work done by the students in the Testing Materials Laboratory includes tests to determine the modulus of elasticity, limit of elasticity, yield point and tensile strength of steel bars; tests of the deflection and of the transverse strength of a wooden beam subjected to a transverse load; tests to determine the modulus of elasticity and tensile strength of wire; tests on cement mortars, including practice in laboratory methods.

40. Mechanical Drawing.

This course extends throughout the first year and is taken by all first year students. The work is planned on the assumption that the student has had no experience in the use of drafting instruments, and so at the start he is taught the mechanical processes involved in the use of the various instruments. Then he takes up line work, use of French curve, geometrical constructions, tracing, and simple projection work.

A student who has completed work equivalent to the course, before entering the School, may, upon presentation of his plates and the passing of a satisfactory examination, be excused from the work at the discretion of the instructor in charge.

42. Descriptive Geometry I.

The course covers the simpler problems on the point, line and plane and various constructions in the projection of solids, including sections and developments.

In the latter half of the course, the problems on the line and plane are completed, and the projection of solids is continued through the intersection of solids bounded by plane faces. Isometric drawings and several practical applications are given.

43. Descriptive Geometry II.

PREPARATION: 42.

The course is a continuation of Descriptive Geometry I, and deals with single and double curved surfaces; their intersection by oblique planes, tangent planes, penetrations, development, and so forth. Various practical problems are given to illustrate the applications of the principles studied.

50. Surveying I.

PREPARATION: 10, 11.

This course consists of two lectures, or recitations, per week during the first year. The student is taught the theory of the various instruments used in plane surveying, the methods of carrying out various surveys, and the application of contour maps to the solution of problems of drainage, road location, landscape engineering, etc. The text-book used is The Principles and Practice of Surveying by Profs. Breed and Hosmer, Vol. I.

50A. Surveying I A.

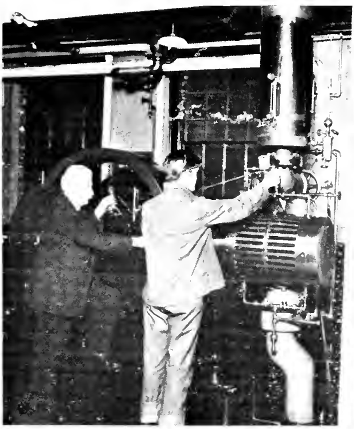
This is a brief course for students taking Courses II and III, to give them instruction in the essential principles of surveying practice.

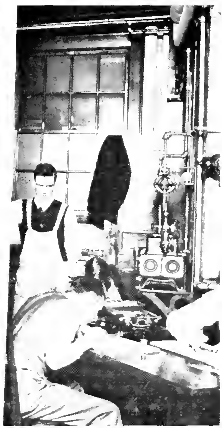
51. Surveying I (Fieldwork and Plotting).

PREPARATION: 50.

This course is taken simultaneously with Surveying I, and consists of six hours of exercise per week throughout the year. The student is taught the use of the chain, tape, compass, transit, and various forms of leveling instruments. The work in the drawing room consists in making the computations which arise in the work of a surveyor, and in making scale drawings by the methods in common use.

CLASS IN THE ELECTRICAL LABORATORY





ENGINEERING LABORATORY
Taking Indicator Diagrams

52. Surveying II.

PREPARATION: 50, 51.

This course is a continuation of Surveying I, and consists of two lectures, or recitations, per week throughout the second year. The student is taught the theory of the stadia and plane table in topographic surveying, the methods of making astronomical observations, and of conducting city and photographic surveys. The text-books used are The Principles and Practice of Surveying by Profs. Breed and Hosmer, Vols. I and II.

53. Surveying II (Fieldwork and Plotting).

PREPARATION: 52.

This course is taken simultaneously with Surveying II and consists of six hours of exercise per week throughout the second year. A stadia survey is first made and later a topographical map made from the notes taken in the field The practice of plane table surveying, the determination of elevations by barometer, and the conduct of photographic surveys are also studied.

54. Topographical Drawing.

PREPARATION: 50, 52.

This course consists of two hours of exercise per week throughout the year. A study is made of the different topographical signs used on surveying maps, both in pen and ink and in wash color. Each student is required to make a number of plates of each kind of topography, and to become reasonably proficient in the making of topographical maps.

56. Highway Engineering.

PREPARATION: 57.

This course consists of one lecture, or recitation, a week throughout the year. A study is made of the principles governing the location, construction, and maintenance of roads, and the construction and maintenance of the various kinds of pavements for city streets. The text-book used is Baker's work on Roads and Pavements.

57. Railroad Engineering.

PREPARATION: 50, 51, 58.

This course consists of three hours of exercise a week throughout the year. A study is made of the mathematics of the various curves used in engineering, with their application to the location of railroads, highways, sewers, pipe lines, etc. The easement curve is also studied, and the various methods of staking out and computing earthwork. The text-books used are Prof. Allen's Railroad Curves and Earthwork, and his Field and Office Tables.

58. Railroad Fieldwork and Drawing.

PREPARATION: 57.

This course consists of six hours of exercise a week throughout the year. A reconnoissance is first made of a railroad about a mile and a half in length, followed by a preliminary survey with transit and level for the determination of contours, as a basis for fixing the location survey. All this work follows modern practice in laying out railroads. The greater part of the fieldwork is devoted to a systematic drill in running in curves of various kinds, including transition curves, and in staking out fieldwork. The drawing consists in plotting up the preliminary survey of the railroad surveyed.

70. Theory of Structures.

PREPARATION: 31.

This is a course of thirty exercises in the third year, devoted to class and drawing-room work in studying the loads, reactions, shears and moments acting upon structures of various kinds as roofs and bridges. A thorough study is also made of the various functions of the influence line and the methods used to determine the position of moving loads to produce maximum shears and moments on bridges. The text-book used is Prof. Spofford's Theory of Structures. A study is also made of the practical design of beams and girders.

71. Theory of Structures, Bridges and Similar Structures.

PREPARATION: 70.

This course treats of the computation and design of structures of wood, steel and masonry, by analytical and by graphical

methods. The subjects considered are: the plate girder, roof and bridge trusses of various types; such as simple trusses, bridge trusses with secondary web systems, including the Baltimore and Pettit Trusses, and trusses with multiple web systems, lateral and portal bracing, transverse bents, viaduct towers and cantilever bridges. A study is also made of the design of columns, tension members, pin and riveted truss joints, trestles of wood and steel, and arches of metal and stone. In the latter part of the course the student is given training in the use of the standard handbooks in structural work. The object is to train the student thoroughly in the application of mechanics to the design of structures. The textbook used is Prof. Spofford's Theory of Structures.

72. Advanced Structures.

PREPARATION: 71.

This course consists of a thorough study of graphical statics, after which it treats of the computation and design of retaining walls, masonry dams, masonry arches, continuous girders, and movable bridges. Only the more simple cases are considered.

73. Structural Drawing.

The course in structural drawing consists of one exercise of two hours each week throughout the third year in the drawing room, devoted to the drawing of standard sections of structural steel shapes and connections, and the preparation of drawings, representing elementary structural details. This course is designed to familiarize the student with the conventional signs for riveting, riveted connections and the dimensioning and detailing of structural parts.

74. Structural Design.

PREPARATION: 72.

A course of six hours per week, throughout the fourth year, in which the students are instructed in the design of structures of wood, stone and metal. Each student is given a set of data, and is required to perform all the computations and to make de-

signs and working drawings for structures, such as plate girder bridges and wooden roof trusses. His work is criticized as it progresses.

80. Concrete Construction.

PREPARATION: 72.

A course consisting of lectures and drafting, in which instruction is given in the theoretical and practical principles involved in the design of structures of plain and reinforced concrete. The course includes a study of the simple reinforced concrete beam, the design of slabs, T-beams, columns and footings. Instruction is given by means of lectures and text-books, in conjunction with which each student is given practical problems in design to be worked out in the drawing room.

80A. Concrete Design.

A course of three hours per week throughout the fourth year, in which students are given instruction in the design of structures of concrete, plain and reinforced. Each student is given a set of data, and is required to make all computations and to make designs and working drawings for several concrete structures, including a masonry dam, plain concrete arch, a reinforced concrete floor system and a reinforced concrete retaining wall.

81. Materials.

PREPARATION: 72.

This course consists of two lectures, or recitations, per week throughout the third year, in the study of the methods of manufacturing, properties and strength of various materials used by the engineer, such as brick, cement, concrete, iron and steel. A study is also made of the properties of wood and stone. The text-book used is Johnson's "The Materials of Construction."

82. Foundations.

PREPARATION: 71.

A course of eighteen lectures during the fourth year. The subjects treated in this course are as follows: Building stones and concrete, bearing power of different kinds of soil, examination

of the site, designing the footings, whether of masonry, or of steel and concrete, independent piers, pile foundations, compressed air processes, freezing processes, retaining walls, together with some details of buildings for industrial purposes, constructed of steel, or of reinforced concrete. Baker's Masonry Construction is used as a text-book.

90. Mechanism and Valve-Gears.

PREPARATION: 11, 40, 42

This course includes a systematic study of the motions and forms of the various mechanisms occurring in machines, and the manner of supporting and guiding the parts.

The latter part of this work is devoted to a discussion of the fundamental systems of gearing, together with their applications and limitations.

The theory and practice of designing valve-gears for steam-engines, including the plain slide valve, link motions, radial valve-gears, double valves and drop cut-off valves are also studied.

91. Mechanical Engineering Drawing.

PREPARATION: 40, 90.

In this course the student makes drawings showing the application of simple machine details, such as bolts and nuts, screws, springs, keys, flanges, pipe fittings, etc.; systems of dimensioning, conventional representations, and blue-printing are also taught. The larger part of the work consists of drawing, illustrating the class-room work in connection with the courses in Mechanism and Valve-gears, including the design of cams, gear-teeth, slide-valves, double valves, etc.

92. Machine Drawing.

PREPARATION: 91.

The aim of the course is to teach the proper way of making the necessary dimensioned drawings for use in practice, good shop systems being adopted. The instruction includes the making of working detail and assembly drawings of machinery from measurements.

93. Machine Design, Statics and Dynamics.

PREPARATION: 91, 31.

The main object of the course is the application of principles already learned to the solution of problems in design. For each design the constructive details are carefully discussed; each student then makes all the necessary calculations to determine the dimensions of every part, and finally he completes the working drawings. The scope of the designs is such as to include most of the elementary principles of design, and yet is sufficiently limited to enable the student to complete every detail, as it is believed that only by such thorough work can real benefit be obtained.

The work in Dynamics includes a number of the principal applications of Dynamics to moving machinery such as governors, fly-wheels, the action of the reciprocating parts of the steam-engine, running balance, whirling speed of shafts, etc. The work is supplemented by a course in drafting.

Problems of both static and dynamic nature are given, illustrative of the principles studied.

Many problems illustrating the methods of determining the stresses in machine parts are given in connection with the course.

95. Heat Engineering: Thermodynamics and Boilers.

PREPARATION: 10, 11, 31.

It includes a study of the principles of thermodynamics; a discussion of the properties of gases, saturated and superheated vapors, especially of air and steam; of the flow of fluids through orifices, nozzles, pipes and meters, a discussion of the action of the steam injector; a study of the various cycles of the hot air, internal combustion and steam engines, of the turbine, air compressor and refrigerator systems. These engineering applications are treated from the physical, analytical and graphical points of view, so as to give the student a good foundation in the principles of thermodynamics, in the solution of actual heat engineering problems. The course also includes a study of the simple, compound and multiple expansion steam engine, of the

different types of gas engines, of the gas producer, of compressed air and refrigerator machines, and the methods of testing such machines.

The various types of steam boilers with their advantages and applications as regards construction, installation and operation, form the latter part of the course. Steam turbines are also discussed.

96. Power Plant Design.

PREPARATION: 31, 93, 95.

The course consists largely of drawing-room work and calculations, with such lectures as may be needed from time to time. The work of the course consists in making the working drawings necessary to show the location of boilers, engines, auxiliaries, piping, coal pockets, etc., for a power house, and also drawings and calculations of some of the details.

97. Engineering Laboratory.

PREPARATION: 95.

This course consists of exercises and tests upon the various forms of appliances in use in the power plant, such as:

Setting Plain Slide Valves, Riding Cut-off Valves, Corliss Valves, etc.

Analysis of Flue Gases.

Calibration of Pressure and Vacuum Gauges.

Calibration of Orifices and Nozzles.

Flow of water over weirs and through a Venturi Meter.

In addition to the foregoing, exercises are given on the Steam Calorimeter, Flow of Steam, Air Fans and Blowers, Flow of Air, Smoke Observations, Steam Boiler Testing, and Steam Engine Indicator Practice.

99. Foundry Practice.

A lecture course in which is studied the general principles and practice of pattern making, and taking up a consideration of sands, tools, molds, cores, ramming, venting, facing, spruing, risers, gateing, use of chills and simpler types of sweep molding.

100. Boiler Design.

PREPARATION: 95.

This course is devoted to a consideration of the most modern methods of boiler designing and construction. In connection with the lectures, the student is required to make calculations and drawings necessary in the design of some approved type of boiler.

101. Forging Chipping and Filing.

This course consists of one two-hour exercise per week, or its equivalent. In the forging work, the student is instructed in the building and care of fires, heating, drawing, bending, upsetting and welding.

The exercises in Chipping and Filing give instruction about the various tools and files used, and then the student is given practice in their use by various problems in chipping chamfers, keyways, etc.; and then in filing problems, as parallel surfaces, filing to template, slide and drive fits, etc.

102. Wood-working and Pattern Work.

This is a course designed to give students facility in the common operations of carpentering and cabinet work, together with the use and care of wood working machinery, as lathes, saws, planers, etc. The course includes instruction in Woodturning having special application to Pattern-work, an illustrated discussion of the principles of moulding, to explain clearly and show reasons for "Draft" on patterns and methods of allowing it, instruction in the use and making of core-boxes, and methods of building up patterns.

103. Machine Work.

This course is to train students in the common operations of metal working, as chipping and filing, forging, and machine work, as that done on lathes, drill presses, shapers and milling machines.

104. Factory Construction and Management.

This course embraces a study of the types of buildings used for manufacturing purposes and the principles of construction, cov-

ering brick and stone work, floors, columns, and roofs. The use of concrete, the principles of slow-burning construction, the methods of fire protection, and the elementary principles of shop sanitation are considered in this course. It also includes a study of the organization and relations of the various departments of an industrial establishment, process mapping, or routing, scheduling of work, the office and engineering departments, methods of superintendence, and a brief discussion of cost accounting.

110. Hydraulics.

PREPARATION: 31.

A course of three exercises per week, during the third year, taken by all students. Both Hydrostatics and Hydrodynamics are discussed and numerous practical problems are solved throughout the work.

Under Hydrostatics, the pressures on submerged areas, together with the points of application are studied, while under Hydrodynamics, the flow of water through orifices, short tubes, nozzles, over weirs, and through pipes and open channels are taken up for discussion.

111. Hydraulic Motors.

PREPARATION: 110.

A series of exercises, mainly recitations, based upon a text-book, so as to embrace the laws of flow in open channels, and of the dynamic pressure and work of water flowing over curved surfaces. The time is principally given, however, to a study of impulse wheels and reaction turbines, with reference to their proper construction, regulation and testing, and to the various sources of loss of energy in their operation.

112. Hydraulic and Sanitary Engineering.

PREPARATION: 110.

This course treats of the drainage of lands, together with a course in irrigation, in which are studied the constructions and methods employed in this and other countries, including the arrangement and proportioning of canals and distributaries, and

modes of applying water to the soil. A study is also made of the location and capacities of reservoirs and the location and construction of earth and loose rock dams. The student is instructed in the use of hydraulic diagrams for the discharge of conduits and canals, and the flow of water in open channels. Instruction is also given in the theory and practice of stream measurements and the various methods and instruments used in stream gauging. The text books used are Wilson's, Irrigation Engineering, Swan and Horton's, Hydraulic Diagrams, and Hoyt and Grover's River Discharge.

120. Electrical Transmission of Power.

PREPARATION: 128, 139.

This course is devoted to a thorough study of the design and construction of modern high tension transmission lines. It is in two sub-divisions, the first dealing with the electrical characteristics of the line, such as: potentials used, size and spacing of conductors, inductive and capacity reactance, skin effect, coronal loss, effect of harmonics, conditions of resonance, effect of high tension lines on neighboring circuits, etc.; the second, covering the parallel problems of rights of way, location of poles, towers and conduits, insulation and insulating devices, protective devices against lightning, flash overs, etc., and, in brief, a discussion of the problem of material realization of the line, as previously planned and calculated.

121. Central Stations.

PREPARATION: 111, 95, 128, 139.

This course is given to a consideration of the central station for the production of electrical power, by both Steam and Hydraulic prime movers. Very little time is given to the consideration of either steam engines, steam or hydraulic turbines, or electric generators, transformers, etc. The time is taken by a careful discussion of the problems of development of a water power, and location of a steam plant, probable field for consumption of power developed, organization of the plant, design, etc. Particular attention is given to the problems of control, protection of apparatus, and switchboard devices. The course is in the form of lectures with free use of published descriptions of existing plants, collateral reading, etc.

122 A. Electrical Engineering I, Laboratory and Reports.

PREPARATION: 126, 128.

This course of exercises is given throughout the second year, and is devoted to a carefully selected series of experiments, intended to exemplify in the simplest manner the use of the voltmeter, ammeter and wattmeter, on the one hand, and on the other, a series of experiments illustrative of the principles developed in the courses on Direct Current Machines and Direct Current Practice. The purpose of this course being, in part, to develop correct methods of work, it is intended that practically the whole of the preparatory work and working up of results shall be done in the laboratory, under guidance of the instructor, so far as necessary.

122 B. Electrical Engineering II, Laboratory and Reports.

PREPARATION: 122 A.

This course is given over to the study of the characteristics of direct current machines, involving an investigation of such matters as: Characteristic Curves of different types of generators, Speed and Torque Curves of Motors, Heat Runs, etc. Then follows a series of experiments involving the testing of machines for Efficiency, and as the course progresses the student is thrown more and more upon his own resources; a desired result is stated to him, and he is required to plan out his own method, settle upon the apparatus needed, solve his precision requirements, calibrate his instruments, if necessary, and finally turn in a detailed report covering all phases of his work.

123. Studies in Eectrical Construction.

PREPARATION: 120, 121.

This course, which is given in connection with No. 120 and No. 121 consists of visits to plants, manufactories, etc., so far as possible, and written papers by the students upon the various questions involved, together with the reading of the same and their discussion by the class.

124. Intercommunicating Telephones.

PREPARATION: 126.

A course of lectures in the construction, operation and maintenance of factory intercommunicating telephone sets.

125. Electrical Problems.

PREPARATION: 126.

This is purely a recitation course, based on Lyon's "Problems in Electrical Engineering" as a text book, and covers the matter contained in the first eight chapters (omitting the seventh) namely: Resistance, Ohm's Law, Kirchoff's Laws, Energy and Power, Direct Current Generators and Motors, and the Electromagnetic Field. It is really designed for the working out of actual engineering problems, illustrating and developing the matters discussed in the parallel courses of Theoretical Electricity, Direct Current Machinery and Direct Current Practice.

126. Elements of Electricity.

PREPARATION: 10, 20.

This course of thirty-six experimental lectures is taken by all students of the School during the first year. In it are discussed the fundamental principles of Magnetism, Electro-statics and Electro-kinetics, the subjects being taken up from the view point of the most recent hypotheses regarding the nature of Electricity and its modes of manifestation. The text-book used is Kimball's Physics.

127. Theoretical Electricity.

PREPARATION: 126, 128, 129.

This course, taken during the second year, covers such subjects as the comparison of the Electrostatic and Electro-magnetic systems of measurement, the determination of the absolute units of potential difference, current, and resistance, with their relationship to the various International Units, and other similar matters; a consideration of the transfer of electricity through solid, liquid and gaseous conductors, concluding with a discussion of the Electronic Theory. No one text-book is used.

123. Direct Current Machinery.

PREPARATION: 126, 127.

This course, which runs parallel with No. 127, returns to the starting point of the inducing of an Electromotive force by motion of a conductor in a magnetic field, and discusses in detail

the theory of direct current generators and motors, armature winding, characteristic curves, etc. The text-book is Franklin and Esty; Direct Current Machinery.

129. Direct Current Practice.

PREPARATION: 128.

In this course, which follows immediately after No. 128, requiring it as preparation, is given some detailed study of the operation of direct current apparatus, the Edison 3-wire system of distribution, storage batteries, and the more important industrial applications of direct current power.

130 A. Technical Electrical Measurements, Lectures.

PREPARATION: 128, 129.

This course, given in the third year, is intended to familiarize the student with the principal types of electrical measuring instruments used in testing, their manner of use, sources of error and necessary precautions to be taken, as well as the leading methods of measuring with precision, the various electrical quantities as,—Resistance, Current, Electromotive force, Capacity, Inductance, Conductivity, etc.

130 B. Technical Electrical Measurements, Laboratory and Reports.

PREPARATION: 130A.

This course, given during the third year, and running parallel with 130A, consists of a series of experiments intended to bring out the principles therein developed, and involving such matters as the determination of Specific Resistance, Insulation Resistance, Conductivity, Magnetic induction, Electrostatic Capacity, and the use of special apparatus, such as the Kelvin Bridge, Cary-Foster Bridge, Potentiometer in the calibration of voltmeters and ammeters, etc.

All through, particular stress is laid on the correct use of apparatus and methods, and precision discussions are required throughout.

131. Wiring and the National Code.

PREPARATION: 126.

This course does not pretend at all to teach the student so called "Practical Wiring," but is intended to explain the principles governing the wiring of buildings, to illustrate the leading types of fittings used, and to give a careful survey of the requirements of the National Electrical Code, as promulgated by the Electrical Committee of the National Fire Protection Association, and adopted into their municipal law by all the leading cities and towns of the United States and Canada.

132. Illumination and Photometry.

PREPARATION: 20.

A course of lectures dealing with the application of electricity to lighting, the principles of illumination, and the laboratory measurement of the various quantities concerned. The textbook used is Wiekenden's Illumination and Photometry.

133. Electric Railways.

PREPARATION: 128, 129, 139.

A course of lectures, including a discussion of the general problem of supplanting steam with electric traction, followed by a discussion of the principal systems of electric traction, namely, Direct Current, high and low voltage, Single Phase Alternating Current systems and Three Phase Alternating Current systems, and a study of the construction, equipment, and cost of operation of existing systems.

134. Practical Electricity I.

PREPARATION: 10, 20, 126.

The course is given to all students in the Civil, Chemical, and the Mechanical Engineering Courses. The principles of electricity and magnetism discussed in Elementary Electricity are applied in this course to the solution of practical problems of the two and three wire direct current systems, and to the study of direct current generators and motors. The student will also be instructed in wiring, together with the rules of the National Electrical Code.

135. Practical Electricity I., Laboratory.

PREPARATION: 134.

A series of twelve practical experiments illustrating and depending on the problems and principles given in Practical Electricity I. Elementary tests on direct current machines.

136. Practical Electricity II.

PREPARATION: 134, 135.

This is a continuation of Practical Electricity I. The first part of the year will be devoted to a study of storage batteries, photometry, and the general principles of Alternating Current, series and parallel circuits. The last half of the year will be devoted to a study of the various types of Alternating Current Machinery and the application to present day conditions.

137. Practical Electricity II., Laboratory.

PREPARATION: 136.

Twelve experiments on the testing of electrical machinery, both direct current and alternating current, also photometry of incandescent lamps.

138. Alternating Currents.

PREPARATION: 128, 129.

This course concerns itself with the general theory of alternating current circuits, and the application of these principles to various engineering problems. In connection with the work, considerable importance is attached to the solution of problems selected with reference to their engineering application, two hours per week being devoted to this work.

139. Alternating Current Machinery.

PREPARATION: 138.

This course of lectures, recitations and problems, is devoted to a careful discussion of the various types of alternating current machinery for the generation, transmission and distribution of power. The special properties of each machine are considered for the machine as a unit, and when it is used as a part of any

electrical system; some of the general considerations concerning long-distance power transmission are also included. Two one hour periods per week are devoted to the solution of various problems pertaining to the work.

139A. Alternating Current Machinery Laboratory.

PREPARATION: 138, 139.

The work includes such tests as efficiency, heating, regulation and determination of characteristics for alternating current machinery. The work in the laboratory is supplemented by conferences.

140. Chemistry E I.

This is an experimental lecture course covering chemical practice as applied to engineering work. It treats of the gases used in the arts, as hydrogen, oxygen, acetylene, etc.; their preparation, properties and uses, as well as the oxyhydrogen blow pipe, oxy-acetylene blast, etc. Paints, concrete, alloys, corrosion and its preventives, are also dealt with. In addition to this, the work takes up oils, fuels, fuel gases, explosives, glass, mineral insulators, the commonly used acids and bases, etc. The consideration is taken up from the engineer's standpoint, rather than the chemist's.

141. Chemistry E II.

PREPARATION: 140.

This is a continuation of Chemistry E I, in which the consideration of the various subjects is concluded.

142. Inorganic Chemistry.

PREPARATION: 10, 20.

The fundamental principles of the science are taught in connection with the descriptive chemistry of the non-metallic elements. The lectures are designed to precede the work of the laboratory, in which the students are expected to verify and illustrate the principles and facts which have been discussed in the lecture room. Careful manipulation, thoroughness in observation, accuracy in arriving at conclusions, and neatness in note-taking, are required of each student. The course lays the necessary foundation for subsequent chemical study.

143. Qualitative Analysis.

PREPARATION: 142.

A practical course in qualitative analysis for the separation and identification of the common metallic elements and the acids. Each student is also required to make a complete and accurate analysis of various mixtures, alloys and chemicals used in manufacturing. The laboratory work is supplemented by a course of lectures and conferences, devoted to a general study of the properties of the common metals and their compounds.

144. Quantitative Analysis.

PREPARATION: 142, 143.

A course in gravimetric and volumetric analysis. Special attention is given to accurate manipulation, the preparation of standard solutions, the calibration of instruments, and to the principles of stochiometry. The laboratory work is supplemented by a course of lectures and conferences.

145. Organic Chemistry.

PREPARATION: 144.

A course of lectures on the principles of organic chemistry, as illustrated by the methane and benzene derivatives.

145A. Organic Chemical Laboratory.

PREPARATION: 145.

The course aims to familiarize the student with the common apparatus and general procedure used in organic work. To this end he carries out such operations as fractional distillation, extraction, crystallization, and determinations of boiling and melting points. The compounds prepared are such as to give instruction in general methods of preparation as: oxidation, reduction, saponification, nitration and sulfonation.

The student also makes a study of the general principles of organic analysis, and carries out the quantitative determination of carbon, hydrogen, nitrogen and a halogen in organic compounds.

146. Industrial Chemistry.

PREPARATION: 143, 144, 145.

This course consists of a series of lectures and recitations upon the more important technical chemical processes, including those

of Metallurgy. Much attention is given to the general operations common to many industries, such as crushing, grinding, lixiviation, filtration, evaporation, distillation, crystallization, etc., and to the details of various types of apparatus used for carrying on these processes. Some of the more important manufacturing industries, such as the production of alkali, fertilizers, glass, pigments, cement, soap, explosives, paper, as well as wood distillation, the refining of petroleum, etc., are also considered in detail.

146 A. Industrial Chemical Laboratory.

Preparation: 146.

A course in the quantitative study of the preparation and purification of some chemical product, selected as a type of reaction of industrial importance. The processes employed are carefully controlled and the final product is analyzed to determine its purity. When the work is completed, a careful detailed report of the whole process is made and discussed in class.

147. General Metallury.

In this course a study is made of the ferrous and non-ferrous metals most used in engineering work. The production of iron, steel and the more common non-ferrous metals is taken up, and the characteristic properties of each substance are studied, together with its more common uses. Corrosion and its prevention, together with bearing metals, and the more commonly used alloys are given thorough consideration.

148. Technical Analysis.

Preparation: 145.

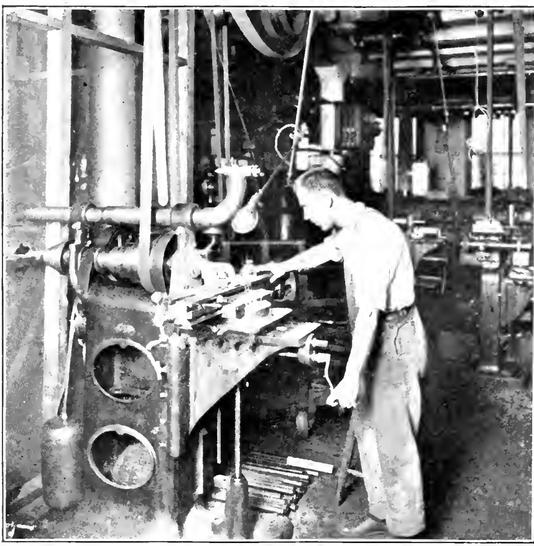
A course devoted to the following:—

Analysis of gases.

Analysis of oils, mineral and vegetable.

The origin, manufacture, properties, uses and analysis of the various fuels, and the determination of the heat value of fuels by the use of a calorimetric bomb.

CHECKING VOLTMETERS
Head Place Station
Edison Electric Illuminating Company



MILLING INSULATOR ENDS
Machine Shop
Boston Elevated Railway Company

149. Theoretical Chemistry.

PREPARATION: 142, 143, 144.

In this course the more important principles of Theoretical Chemistry are considered; but these are treated with great thoroughness and are illustrated by applying them to a large variety of problems. The principles are further illustrated by lecture experiments. During the course the following subjects are considered: pressure volume relations of gases and solutions, derivation of molecular and atomic weights, conductivity of solutions, ionic theory and mass action law, effect of temperature on chemical equilibrium, the laws of energy with reference to the production of heat and work, the electro-motive force of voltaic cells and other electro-chemical topics.

149A. Theoretical Chemistry Laboratory.

This course comprises a series of exercises to give the student a knowledge of the methods employed in molecular weight determinations, in studying the important properties of solutions. While reasonable accuracy is required, especial emphasis is laid on the underlying principles upon which all work of this character is based.

150. Chemical Engineering.

The aim of this course is to train the student to get a clear comprehensive estimate of chemical engineering work, such as he may be called upon to do in the ordinary pursuit of his profession, and to deduce correct and practical inferences from his studies. To this end a carefully planned, systematic study is made of the more important operations as they are carried out in industries of a chemical nature. The various types of equipment, capable of being used for such work, are studied as well as the types which are best suited to certain kinds of work.

160. Dynamical and Structural Geology.

This course treats of earth movements and the various terrestrial applications of solar energy. The more important geological processes, erosion, sedimentation, deformation and eruption are taken up and discussed.

The latter part of the course is devoted to lectures on the broader structural features of the earth's crust and the application of the principles of structural geology to practical engineering problems.

170. German I.

This course is planned to give the student a knowledge of German grammar, as well as a working vocabulary of scientific terms. During the course, easy scientific reading is begun.

171. German II.

PREPARATION: 170.

A continuation of German I, in which the student is given full opportunity to extend his vocabulary of technical words, as well as to become familiar with technical books and scientific articles in the current German periodicals.

172. Spanish.

A course in Spanish given to enable the student to understand and speak the language of the South American countries, so that he may be ready to take a part in our trade expansion, if he so desires. The work is optional for any student in the School.

200. Engineering Practice.

This covers the courses in practical engineering work which the student gets with his employing firm. The exact duties performed vary with the different courses, and also vary with the firm. The students are marked for their work bi-monthly and the grades received are regularly noted on the report cards which are sent out every two months.

EQUIPMENT.

The School is now housed in the new building of the Association, and has very exceptionally equipped quarters for carrying on the work of the Engineering Courses.

MECHANICAL DEPARTMENT.

Mechanical Laboratories.

Through the courtesy of the Massachusetts Institute of Technology officials, and also those of the Franklin Union, and Wentworth Institute, we are able to avail ourselves of the unexcelled Engineering Laboratories of those Institutions for instruction purposes in the laboratory Courses of the Co-Operative School.

In addition to the foregoing facilities, we have several engines of our own for use for instruction, as well as the most modern equipment for gas and fuel analysis.

Our own steam engineering plant is completely equipped with meters, scales, indicators, and all the necessary accessory equipment for making complete boiler tests, and determining the efficiencies of the various appliances used in generating power, heat, and light for our new building. This places at the disposal of our classes a perfectly equipped, up-to-date, engineering department, and gives them the means of carrying on boiler tests, determining the efficiencies of various fuels and oils, taking indicator diagrams, determining the efficiency of modern reciprocating engines and turbines when direct connected to generators, as well as renders them familiar with all the various auxiliary appliances of such a plant, as condensers, pumps, air compressors, etc. The students also have the use of the equipment of our Automobile School, thus giving opportunity to study the most advanced ideas in gasoline engine practice.

MECHANIC ARTS LABORATORIES.

There are at present two laboratories, one for metal work and the other for wood working and pattern work, which are available for the use of our students.

The metal working laboratory is well equipped, and affords the student an opportunity for work with various machines, as: lathes, shapers, drill presses and milling machines. There are also a gas forge and brazing furnace, together with all the required equipment for bench work instruction.

The wood working laboratory has a power band saw, lathes, circular saw, buzz planer, and all the necessary equipment for wood working and pattern work.

In addition to the foregoing, a small but completely equipped, shop for the construction and repair of apparatus, and for the use of students in connection with their thesis work has been installed. This shop is equipped with a metal and wood working lathe, grinder and all the necessary wood and metal working tools. There is also a very complete set of cabinet worker's tools for use in wood working.

CIVIL ENGINEERING DEPARTMENT.

Field Instruments.

For work in the field, the Department possesses various surveying instruments, representing the principal makes and types of instruments in general use. The equipment includes transits, levels, compasses, a complete plane table outfit, Locke hand level, flag poles, leveling rods, stadia rod, engineers' and surveyors' chains, steel and cloth tapes and other accessories. For Higher Surveying, an Aneroid Barometer is used for barometic leveling, and the transits are equipped with neutral glasses and reflectors for astronomical observations, as well as a sextant, reading to ten seconds, and equipped with neutral glasses and telescopes. This year a Buff and Buff No. 1 Engineer's Transit has been added to the equipment.

The scope of the equipment and the fieldwork itself are designed to train the student's judgment as to the relative merits of the various types of field instruments.

Design and Drafting Rooms.

The School possesses large, light and well equipped drawing rooms for the carrying on of the designing and drafting, which form so important a part of civil engineering work. These rooms are supplied with lockers containing the drawing supplies, and files containing blue prints and photographs of structures that represent the best practice. Many of the prints and photographs are of structures erected in and about Boston.

ELECTRICAL ENGINEERING DEPARTMENT.

The Electrical Laboratory is well equipped with apparatus for teaching the principles of measurements, and the equipment is being steadily increased and developed for the doing of work of a higher degree of precision. Among the special pieces of apparatus may be mentioned the following: Cary Foster Bridge, a modified form of Hoopes Conductivity Bridge, a Laboratory Wheatstone Bridge, a Leeds Northrup Potentiometer with Volt box, standard cells and low resistance standards, an accurate Chemical Balance and other appliances for the close determination of currents, resistances and potential differences.

There was added last year a set of variable inductances, and a set of condensers to the amount of eighty microfarads capacity variable in steps of one-tenth microfarad each.

Among the instruments for testing purposes, for alternating current work, may be mentioned the following: Three matched voltmeters and three General Electric Type P-3 Iron clad wattmeters arranged for Y connection, one G. E. Polyphase Wattmeter with double current and potential ranges, numerous other voltmeters of various ranges, potential transformers, numerous ammeters some with current transformers, three integrating meters, one General Electric and one Westinghouse polyphase, switchboard type, integrating wattmeters and a High Torque General Electric test meter. There is also a considerable and increasing assortment of auxiliary testing apparatus, such as synchronism indicators, power factor indicators, frequency indicators, etc.

For direct current testing, there is a large and increasing collection of Weston instruments, both voltmeters and ammeters, of suitable ranges and grades of precision, while the measurement of unusual currents and voltages is ensured by three Weston millivoltmeters with an assortment of standard shunts and multiplying resistances of various orders of magnitude.

For calibrating purposes, a 120 ampere-hour storage battery has been added to the equipment for current tests, while for voltage work, there is a 260 volt potential battery.

There is also the usual assortment of testing devices, such as speed indicators, tachometers, brakes, loading resistances and the numerous minor pieces of apparatus needed in practical testing and operating of electrical machinery.

Among the machines of this Department, are a pair of specially made, matched machines arranged to run as single phase, two, or three, phase generators, or motors, as well as synchronous transformers, double current generators, or on the Direct Current side as shunt, series, or compound, generators, either two or three wire, or as motors.

There are also a 15 horse power 230-volt Westinghouse motor, a new General Eleteric 10 horse power Interpole 230-volt motor, a 500-volt generator, two 500-volt series, and several 500-volt shunt motors, and a series parallel controller.

A 15 K. V. A., 60-cycle, single phase, 500-volt generator giving a practically pure sine wave, three General Electric Type H transformers, each of 3 K. V. A. capacity, a 7 1-2 K. V. A. special General Electric 60-cycle 230-volt alternator, with revolving field tapped for either 1, 2, 3 (star or mesh connection) 6 or 12 phase connection, which may be operated also as a synchronous motor.

During the past year there have been added a 5 H. P. G. E. single phase induction motor, which may also be operated as a three phase motor and a 10 H. P. Fort Wayne shunt motor driving a special Holtzer-Cabot 3 phase 5 K. V. A. Alternating Current Generator. This latter machine has two special rotors, permitting its use as a squirrel cage or phase wound induction motor. A three phase regulating resistance for use with the phase wound rotor, has also just been installed.

There is also available for advanced instruction, in co-operation with the Mechanical Department, the four three-wire generators (two driven by reciprocating engines and two by Westinghouse-Parsons turbines) in the main generating plant of the Association.

DEPARTMENT OF PHYSICS.

There is a large laboratory devoted entirely to Physics together with a lecture room.

The Physics Department has been very completely equipped with all necessary apparatus for the experimental work that is required of the students, as well as that required for lecture demonstration. Among other things have been added: verniers, levels, spherometers, calorimeters, thermometers, pyrometers, a spectroscope, a microscope, a spectrometer, balances, standard gram weight, lecture table galvanometer, optical disk with all accessories, lenses, photometer, a full set of Weather Bureau apparatus, including a barograph, thermograph, hygrometer, barometer, maximum and minimum thermometers, etc. These, in addition to the equipment already owned, give a wide range to the experimental work that can be done.

DEPARTMENT OF CHEMISTRY.

This Department is completely equipped in all respects for carrying on all lines of Chemical work, from that of a High School to that of most advanced College grade. The three laboratories, with accommodations for over one hundred and fifty students, are very exceptionally furnished with all the necessary appliances for chemical work. Some of these are: hoods, drying closets, still, steam and hot water baths, electrolytic circuits, vacuum and pressure apparatus, balances, combustion furnaces, complete sets of apparatus for the sampling and analysis of flue gases and fuels. There are also testing machines for oils, viscosimeters, and different sorts of flash point apparatus. A chemical museum is connected with this Department where are kept specimens for purposes of illustration.

LIBRARIES.

There is in connection with the School a professional library containing books pertaining to both the school work of the boys and to their practical work. In addition to this there also are current periodicals on engineering and scientific subjects for their exclusive use. All members of the School are entitled to take books from the Boston Public Library, and this offers a very unusual opportunity to our non-resident students.

DEPARTMENT OF PHYSICAL TRAINING.

Our new gymnasium with all the latest modern equipment gives ample accommodation for all students.

There is a running track on the grounds adjoining, together with tennis and hand ball courts; also a large natatorium where swimming is taught by competent instructors.

In connection with this Department, there are also six excellent bowling alleys, which may be used by the students upon the payment of a nominal fee.

For all further information, write

The Co-Operative Engineering School,
316 Huntington Ave.,
Boston, Mass.

THE CO-OPERATIVE ENGINEERING SCHOOL

Boston Young Men's Christian Association

Boston, Mass. 19

To the Dean :

I, ... , *hereby respectfully apply for admission to the* . . . . *Engineering Course of the Co-Operative Engineering School for the school year* 19 – 19 , *and submit the following statement :*

Name in full . . . . *Age* . . . .

Residence . . . . *St.* . . . . *City, or Town*

State . . . . *Tel.* . . . .

Parent's (father's) name . . . .

" " *address* . . . .

Graduate of . . . . *High School. Year* . . . .

If not a graduate, how many years were you in High School ? . . . .

When did you leave ? . . . .

Why did you leave ? . . . .

Name of principal . . . .

If employed since graduation, what is name of employer ? . . . .

. . . .

Employer's address . . . .

Names and addresses of two other persons to whom we may direct inquiries concerning you . . . .

. . . .

. . . .

. . . .

Do you plan to complete the full four years' course ? . . . .

Do you wish employment with a co-operating firm ? . . . .

When do you wish to start practical work ? . . . .

Where will you live during the school-year ? . . . .

Weight . . . . *Height* . . . .

Have you any physical infirmities ? . . . .

Is your general health good, fair, or poor ? . . . .

. . . .

. . . .

. . . .

Remarks

GENERAL DEPARTMENTS.

DEPARTMENT OF PHYSICAL WORK

ALBERT E. GARLAND, M.D., B. P. E. Director

The Physical Department is under the best supervision and the aim is to better fit men for their life work by increasing their efficiency, through exercise. We offer : Well equipped gymnasiums, Recreative, Hygienic and Educational Gymnastics. Numerous classes the year round. Shower, steam and electric baths. Best instruction. Medical direction. Hand ball courts.

DEPARTMENT OF RELIGIOUS WORK

EDWIN W. PEIRCE, Director

In order that a young man may secure a well-balanced development and attain a spiritual foundation for successful life work, the Association advises each member in planning his schedule to enter into one or more of the following activities : —

Bible Study, Sunday Meetings of Men, Personal Service Groups and The Twenty-Four-Hour-A-Day Club.

DEPARTMENT OF SOCIAL WORK

DAVID M. CLAGHORN, Director.

The attention of members is called to the many opportunities in the Association for social service, and the following social features :

A Newly Equipped Game Room. The Popular Novel Club.
The Association Congress. The Land and Water Club.
Popular Social Evenings.

DEPARTMENT OF EMPLOYMENT

FREDERICK W. ROBINSON, Director

The Employment Department is, in actual practice, a clearing house for young men seeking work, and employers who wish to engage reliable help. From 5000 to 8000 men apply every year. Members of the Association are given 25 per cent discount from the legal rates and special effort is made to notify them when good positions are open.

BOYS' DEPARTMENT

JAMES G. BARNES, A.B., City Secretary

The physical, social, employment and religious advantages offered to boys from twelve to eighteen years, are similar to those offered to men, as stated above. Membership dues for the boys range from one to six dollars, according to the privileges desired.

THE CO-OPERATIVE ENGINEERING SCHOOL

FOUNDED FOR THE INSTRUCTION OF YOUTH IN THE THEORY AND PRACTICE OF ENGINEERING

Northeastern College

March **Bulletin** 1916

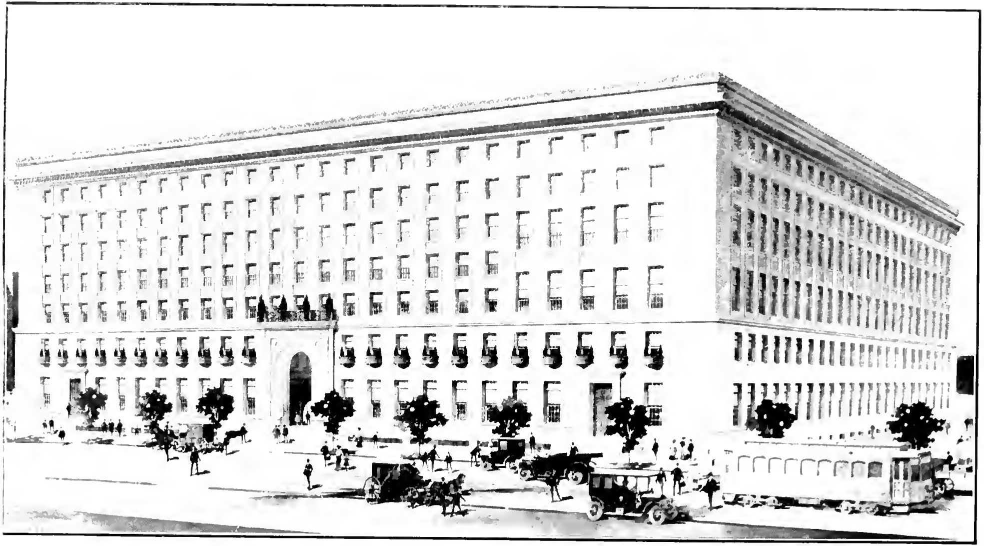
CATALOG

OF THE

CO-OPERATIVE ENGINEERING SCHOOL

1916-1917

PUBLISHED BY
NORTHEASTERN COLLEGE
OF THE
Boston Young Men's Christian Association
Number 316 Huntington Avenue
BOSTON, MASS.



THE NEW ASSOCIATION BUILDING

This is a picture of the new Association Building which was finished in the Fall of 1913. It contains, among other features, school accommodations of the very best, a fine gymnasium, bowling alleys, swimming pool, cafe, dormitories, shops and laboratories, library and reading room, camera clubrooms, social and recreative rooms, and auditorium

Northeastern College

Catalog

OF THE

CO-OPERATIVE ENGINEERING SCHOOL

BOSTON

1916-1917

Catalog of the *Instructing Staff*, together with a Statement of the Requirements for Admission and a Description of the Courses of Instruction

YEARLY CALENDAR

1916

JANUARY

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1917

JANUARY

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JULY

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OCTOBER

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NOVEMBER

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DECEMBER

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School Periods for Division A indicated by type thus: **1 2 3.**
School Periods for Division B indicated by type thus: **1 2 3.**
Periods when School is not in session indicated by type thus: *1 2 3.*

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Calendar 1916

January 17, Monday
Second Term begins for Division A

January 31, Monday
Second Term begins for Division B

February 22, Tuesday
Washington's Birthday (School exercises omitted)

April 19, Wednesday
Patriots' Day (School exercises omitted)

May 29 to June 10, inclusive
Final Examinations

May 30, Tuesday
Decoration Day (School exercises omitted)

June 6, Tuesday
Graduation

June 8-9, Thursday and Friday
First Entrance Examinations of Co-operative Engineering School

June 12-September 9
Summer Vacation

July
Practical work for Division A commences

September
Practical work for Division B commences

September 6-7, Wednesday and Thursday
Second Entrance Examinations of Co-operative Engineering School

September 11, Monday
First Term of school year for Division A commences

September 25, Monday
First Term of school year for Division B commences

October 12, Thursday
Columbus Day (School exercises omitted)

November 30, Thursday
Thanksgiving Day (School exercises omitted)

December 18-26, inclusive
Christmas Recess (School exercises omitted)

Calendar 1917

January 15, Monday
Second Term begins for Division A

January 29, Monday
Second Term begins for Division B

February 22, Thursday
Washington's Birthday (School exercises omitted)

April 19, Thursday
Patriots' Day (School exercises omitted)

May 28 to June 9 inclusive
Final Examinations

May 30, Wednesday
Decoration Day (School exercises omitted)

June 5, Tuesday
Graduation

June 7-8, Thursday and Friday
First Entrance Examinations of Co-operative Engineering School

June 11-September 8
Summer Vacation

July
Practical work for Division A commences

September
Practical work for Division B commences

September 5-6, Wednesday and Thursday
Second Entrance Examinations of Co-operative Engineering School

September 10, Monday
First Term of school year for Division A commences

September 24, Monday
First Term of school year for Division B commences

October 12, Friday
Columbus Day (School exercises omitted)

November 29, Thursday
Thanksgiving Day (School exercises omitted)

December 24-29 inclusive
Christmas Recess (School exercises omitted)

Officers of Administration

General Administrative Officers

ARTHUR S. JOHNSON, *President*

ALBERT H. CURTIS, *Vice President*

GEO. W. BRAINARD, *Recording Secretary*

LEWIS A. CROSSETT, *Treasurer*

GEORGE W. MEHAFFEY, *General Secretary*

Educational Committee

WILLIAM E. MURDOCK   ALBERT H. CURTIS

WM. C. CHICK

MORGAN L. COOLEY   GEORGE H. MARTIN

Educational Administrative Officers

FRANK P. SPEARE, *Director of Education*

GALEN D. LIGHT, *Asst. Director of Educ. and Bursar*

WALTER G. HILL, *Asst. Bursar*

ERNEST H. BROOKE, *Registrar*

F. L. DAWSON, *Field Secretary*

Advisers

The following gentlemen are acting in an advisory capacity on the more important executive matters of the School where their service is of greatest value to us:

DR. RICHARD MACLAURIN, President of Massachusetts Institute of Technology.

JAMES P. MUNROE, Secretary of Massachusetts Institute of Technology Corporation.

WILLIAM MCKAY, General Manager, New England Gas & Coke Co.

PAUL WINSOR, Chief Engineer, Boston Elevated Railway Company.

Officers of Instruction

H. W. GEROMANOS, S. B., Dean
Massachusetts Institute of Technology

CARL S. ELL, S. B., M. S., Assistant Dean
Massachusetts Institute of Technology

J. A. COOLIDGE, S. B.
Mathematics and Physics

LOREN N. DOWNS, Jr., S. B.
Electrical Engineering

D. V. DRISCOLL
Mechanics

CARL S. ELL, S. B., M. S.
Civil Engineering

H. C. MABBOTT, S. B.
Mechanical Engineering

H. W. GEROMANOS, S. B.
Chemistry and Metallurgy

JOHN R. LEIGHTON
Civil Engineering

WALTER I. BADGER, Jr., A. B., M. A.
English

JOHN W. HOWARD, S. B.
Surveying

ERVIN KENISON, S. B.
Descriptive Geometry

W. F. ODOM, S. B., M. S.
Chemical Engineering

THOMAS E. PENARD, S. B.
Mathematics

M. E. PINKHAM
Mathematics

CHARLES H. RESTALL, B. S.
Topographical Drawing

JOHN C. DIETZ, B. A.
Modern Languages

W. LINCOLN SMITH, S. B.
Electrical Engineering

ELLWOOD B. SPEAR, A. B., Ph.D.
Chemistry

EDWARD MUELLER, A. B., Ph.D.
Theoretical Chemistry

At the time of going to press, our annual election of instructors for the year has not been held, and so it is impossible to publish a complete list of the faculty for 1916–1917.

Northeastern College

FOR MANY years the terms Evening Law School, School of Commerce and Finance, and Co-operative Engineering School, have been applied to the corresponding schools of the Department of Education. These names, however, were not distinctive, and both graduates and students have requested that a regular title be given the schools doing work of college grade. As a result of their activities, the schools concerned have been very thoroughly investigated by outside educational experts, to see if the scope and grade of work done would properly measure up to that of the recognized colleges and technical schools. Such was found to be the case in all the schools, and upon the submission of the various reports by the Educational Committee to the Board of Directors of the Association, the latter Board voted to apply the name "Northeastern College" to the group of schools comprising the following:—

Evening Law School
School of Commerce and Finance
Co-operative Engineering School
Polytechnic School
School of Liberal Arts

These schools will henceforth be known as the regular schools of Northeastern College, of the Boston Young Men's Christian Association.

CLASS IN SURVEYING FIELD WORK

Making a Stadia Survey of Jamaica Pond

General Information

IT HAS generally been conceded that where the practical and the theoretical elements of education can be taught simultaneously, the greatest good is derived by the student, and efforts are being made in all departments of education to accomplish this greatly desired end.

Technical school instruction, depending on class-room work and laboratories, must always lack some of the vital characteristics of an actual manufacturing plant, owing to the fact that one is carried on for educational purposes, while the other is operated for dividends. It is this latter fact that gives the Co-operative School idea one great advantage over our usual educational plan. Instead of protecting the student, and training him for several years for a line of work to which he may later find himself to be entirely unfitted, the Co-operative School at once puts the boy to work in a commercial plant. There he learns life in its vital issues, as well as the problem of getting along with men; thus early finding out whether he has made a wise, or unwise, choice of his life work. This training, too, shows him the use and value of his school work, and finally gives him an unusual opportunity to acquire from actual experience that rare thing, *executive ability*, without which his life probably will always be spent on the lower levels of industry.

That the young men of New England might have an opportunity to attend such a technical school, where both practice and theory are correlated, and at the same time be enabled to defray a large part of the expense of their education by the returns from their practical work, the Co-operative Engineering School of the Boston Young Men's Christian Association was started in 1909.

This School has now been in operation for seven years, and the continually increasing interest in it, as well as its rapid and steady growth, show that it was much needed to fill a place that is filled by no other school in this vicinity.

Object of the School

The fundamental aim of this School is to train, for positions in Engineering work, young men who are unable to attend the highest grade technical schools or colleges. Thus they are enabled to advance farther and more rapidly in their chosen work than they could reasonably expect to do without further education than that of a high school course. The training is not in any sense that of a trade school, nor is it exactly that of our best scientific schools, but it stands between the two. The work done is that of a regular engineering school of high standards, but only the essential subjects are taken, and they only so far as they will have a direct bearing on the life work of the student. In other words, it is a limited technical training of high grade. The fact that most of our instructors are graduates of, or instructors in, the Massachusetts Institute of Technology, will show the character of work being done.

At present there are four lines of Engineering work being given, and the end sought is to give to students who have already had a high school preparation, or its equivalent, a good training in the fundamental sciences of Mathematics, Chemistry and Physics, and in the important applications of the principles of these sciences to the several branches of engineering. More stress is laid on the development of the ability to apply the acquired knowledge to new engineering problems, than to the memorizing of a multitude of details and very abstract theory, which, while valuable, cannot be gone into too deeply in a course of this type.

The class-room instruction is given to small sections, and in the drawing rooms and laboratories the students receive a great deal of personal attention. The independent solution of assigned problems forms a large part of nearly all courses.

The courses differ from those of many schools, in that a student is not permitted a wide range of subjects from which to choose, in the belief that better results are obtained by prescribing, after the student has selected the line of work for which he desires to prepare himself, the principal studies which he is to pursue.

Plan of Operation of the School

To illustrate the idea of the curriculum at the School, take, for instance, the case of a young man "A," who desires to take our Mechanical Engineering Course.

"A" is assigned to one of the plants of a firm that is co-operating with us. Here he is put to work, and spends two weeks working for the firm. Then "B," his alternate, who has spent the first two weeks in the School, takes "A's" place with the firm, and "A" puts in the next two weeks at school. Thus the work goes on, the two men exchanging places at the beginning of each two-week period. The studies pursued in the course have a direct practical bearing on the outside work, with the exception of a few courses added, because of the aim which we have to produce a better citizen as well as a better employee. The courses given have been decided upon after conference between the co-operating employers and the school authorities, and are the result of the best ideas of both. The subjects are taught in a practical, not in an abstract or a theoretical way. Thus, in mathematics, instead of teaching algebra, analytic geometry and calculus, as so many separate subjects, they are correlated and taught as instruments for the solution of practical problems arising in engineering work. The aim throughout the course is to give it practical bearing, and yet have it complete and thorough in all the needed essentials.

Correlation of Practical and Theoretical Work

The outside work of the student is as carefully planned as that at the School, and it is progressive. The employers who co-operate with us generally agree, where practicable, to employ the boys in all the different departments of their establishments during their periods of practical duties; this training is just as complete as the school work, and is just as thorough. Where possible, the course of the learner is from the handling of the raw material to the shipment of the finished product. This practical training includes the use of the machines as well as the executive duties of the plant, so that at the end of his course the graduate may not only know how to do things, but also why they are done in certain ways; and he may, we hope, be of value in improving methods of work.

Co-operating Firms

The following is a list of the firms which are co-operating with us at the present time:—

Boston Elevated Railway Co.
Boston & Albany Railroad Co.
Boston & Maine Railroad Co.
Boston Consolidated Gas Co.
Aspinwall & Lincoln, Civil Engineers.
New York, New Haven & Hartford Railroad Co.
Bay State Street Railway Co.
Edison Electric Illuminating Co.
H. F. Bryant, Civil Engineer.
Simplex Electric Heating Co.
Simplex Wire and Cable Co.
Frank E. Sherry, Civil Engineer.
Gray & Davis, Inc., Electrical Devices.
Whitman & Howard, Civil Engineers.
H. F. Beal, Civil Engineer.
Commonwealth of Massachusetts, Land Court.
R. Evans, Essex County Engineer.
United Shoe Machinery Co.
Saunders & Kendall, Civil Engineers.
American Steam Gauge and Valve Co.
J. L. Carr, Civil Engineer.
Dennison Manufacturing Co.
H. C. Red Label Chemical Co.
International Engineering Corporation.
Frank Ridlon Co., Electrical Supplies.
Condit Electrical Manufacturing Co.
Tileston & Hollingsworth Paper Co.

Thus far we have secured new positions for our students as the growth of the School has demanded. However, to be at all sure of work in his chosen branch of engineering, an applicant should file his application early, as the number of positions in any one line is necessarily limited.

Schedules of Practical Work

Below are typical schedules of practical work that have been prepared for our students by some of the companies which are giving them employment:—

Boston Elevated Railway Co.

FIRST YEAR.— Six months, pit work in carhouse.
Six months, armature room.
SECOND YEAR.—Twelve months, machine shop work.
THIRD YEAR.— Six months, mechanical drafting room.
Six months, power station work.
FOURTH YEAR.—Six months, line department.
Six months, electrical engineer's department.

Boston & Maine Railroad Co.

Six months, air brake shops.
One year, erecting work.
One year, machine shop.
One year, engine house repairs.
Six months, drafting room and testing work.

Boston Consolidated Gas Co.

Nine months, data takers.
Three months, office.
Three months, pipe fitter's helpers.
Three months, pump man's helpers.
Three months, blowers and exhausters.
Three months, laboratory.
Three months, boiler room.
Three months, generator house.
Three months, steam fitters.
Three months, machine shop.
Three months, assistant engineers.
Six months, laboratory.
Three months, distribution department.

Simplex Wire and Cable Co.

Six months, Insulating Department.
Six months, Braiding Department.
Six months, Cable Shop.
Six months, Twisting Department.
Six months, Machine Shop Construction Gang.
Six months, Electrical Construction Gang.
One year, Testing Room.

Simplex Electric Heating Co.

Machine Department	1 year	
Grinding Department	1 month	½ year
Stock Department	4 months	
Winding Department	½ month	
Enamelling Department	½ month	
Assembling Department	½ year	
Testing Department, First Division	½ year	
Testing Department, Second Division	½ year	
Shipping Department, approximately	2 months	½ year
Drafting Department, approximately	4 months	
General Shop experience	½ year	

The Condit Electrical Manufacturing Co.

Shipping or Receiving	4 months
Cost and Estimating	4 months
Stock Room	4 months
Machine Department	4 months
Direct-Current Assembly	4 months
Alternating-Current Assembly	4 months
Inspecting and Testing Department	6 months
Experimental Department	3 months
Drafting Department	3 months
Switchboard Department	6 months
Engineering Department	6 months

The Dennison Manufacturing Co.

First Year.—	Carpenter's Helper	4 months
	Pattern Maker's Helper	3 months
	Elevator, Fire Door, Shafting, etc.	2 months
	Helper in Millwright's and Electrician's gangs	3 months
Second Year.—	Machine Shop Stock Room	1 month
	Machine Shop	9 months
	Grinding Room	2 months
Third Year.—	Power Plant work (the time to be put in at the option of the Company)	3 months
	Accident Prevention Work	4 months
	Experimental Work (machine work)	3 months
	Filing Plans, Blue Printing, Tracing, etc.	3 months
Fourth Year.—	Tracing and general work	2 months
	Detailing and general Drafting	10 months

The above programmes show what the boys do in their practical work, and the courses of study pursued at the School show what they do along academic lines. It will be seen that there is the greatest possible degree of correlation between theory and practice in the work they take up. The men under whose supervision the boys have been in their outside work, are practically unanimous in approval of our plan, and speak highly

of the enthusiasm, earnestness and intelligence the students have shown in the performance of their duties.

Attitude of Co-operating Firms

Almost all the concerns which co-operated with us last year took one, or more, additional pairs of our students this year, which in itself is significant of their attitude toward our plan.

Earnings

For the practical work the student does he is paid a certain amount per hour at the start, and a definite increase per hour after completing fixed periods of service. The sum earned is more than enough to pay the tuition and the necessary expenses of schooling, but will not cover the cost of living.

In some cases the boys are paid at a higher rate than is called for by their schedule of pay, but that is a courtesy of the company that gives them employment, and is not in any way to be expected as a regular thing. The co-operating firms may make any salary schedule they desire, so long as it does not fall below that originally agreed upon.

The companies which co-operate with us agree to pay our students ten (10) cents per hour during their first year of service; twelve (12) cents per hour during the second year; fourteen (14) cents per hour during the third year, and sixteen (16) cents per hour during the fourth year.

Basing the earnings on this scale, the student will earn from five (5) to six (6) dollars per working week during the first year, and an increase of approximately one (1) dollar per working week for each succeeding year of the four. As there are about thirty weeks of work per year, the earnings will be from one hundred and fifty dollars upwards.

Frequently a student is able to earn much more than the regular rate, owing to getting extra pay for overtime work.

A census of our students who were working in January, 1914, gave the following data in regard to earnings:—

Minimum weekly wage	$5 00
Maximum weekly wage	12 65
Minimum earnings for January, 1914	9 60
Maximum earnings for January, 1914	31 65
*Minimum earnings for year 1913	150 00
*Maximum earnings for year 1913	375 00

*Based on a total working period of thirty weeks.

Expenses

As the earnings of the students average from $150 to $300 a year, while expense for tuition, books, drafting supplies, etc., and membership in the Y. M. C. A. is not over $125, there is a considerable balance for incidentals.

While the School supplies all books, drawing instruments, slide rules, etc., it has been found impracticable to furnish the students with notebooks, paper, drawing ink, pencils, etc. In consequence of this, the student will have a slight expense, of probably less than two dollars, for paper, pencils, etc.

Relation of the Co-operative School to High Schools

This School is peculiarly adapted to the high school graduate who, although financially unable to continue his studies further, still has the ambition and ability to get ahead if given the opportunity. Thus boys, being graduated from high school, can still live at home, but spend their time in fitting themselves for something better in the future.

This year the School has a student body made up of graduates of the following High Schools:—

Abington High School
Amesbury High School
Beverly High School
Boston English High School
Boston High School of Commerce
Boston Mechanic Arts High School
Brockton High School
Bromfield High School
Cambridge High and Latin School
Canton High School
Chicopee High School
Concord High School
Danvers High School
Dennisport High School
Everett High School
Foxboro High School
Framingham High School
Groton High School
Hamilton High School
Hanover High School
Hardwick High School
Haverhill High School
Hebron Academy
Holden High School
Huntington Preparatory School
Hyde Park High School
Lynn English High School
Malden High School
Marblehead High School
Marlboro High School
Medford High School
Medway High School
Merrimac High School
Milford High School
Natick High School
Newburyport High School
Northbridge High School
North Chelmsford High School
Norwood High School
Peabody High School
Pepperell High School
Petersham High School
Plainville High School
Portland High School (Me.)
Reading High School
Rindge Technical High School
Salem High School
Somerville English High School
Stoughton High School
Sudbury High School
Tilton Seminary
Waltham High School
Westboro High School
Weston High School
West Roxbury High School

MAKING A HIGH POTENTIAL TEST ON A CONCENTRIC FEEDER

Chatham Street Substation Edison Electric Illuminating Company

IN THE RESEARCH LABORATORY

A. D. Little Company, Incorporated, Engineering Chemists

Hydrolyzing Wood Fiber into Alcohol

Number of Students

The number of positions at our disposal in any one branch of engineering is necessarily limited, and so the number of students who can work part time in that line is also limited. In consequence of this, those students who apply first will get first consideration in the matter of positions, and those who wish to enter should present their applications as soon as possible.

Those applicants who apply for admission to the School too late to be assigned to practical work, may attend the School every period, or every alternate period, as they may wish, and will be assigned to practical work as soon as an opening occurs.

Outside Interests

A moderate participation in social and athletic activities is encouraged by the Faculty, although a standard of scholarship is required of the students which is incompatible with excessive devotion to such pursuits.

Four-Year Courses

Regular four-year courses, leading to a diploma, are offered in the following branches of engineering :—

I. Civil Engineering
II. Mechanical Engineering
III. Electrical Engineering
IV. Chemical Engineering

Descriptions of these courses and schedules, showing the subjects of instruction included, will be found on succeeding pages.

Summer Schools

There are day and evening summer preparatory schools, conducted by the Educational Department of the Association, and students having entrance conditions, or requiring further preparation for the entrance examinations, may avail themselves of this opportunity to cover the desired work.

Those of our students who fail to pass in any of their school work may be permitted to take up the study in the Summer School conducted by the Institute of Technology, provided, of course, that Institution is offering such a course. Those students desiring this privilege should consult the Dean, as special permission must be obtained to attend many of the courses.

Physical Training

Those students who desire gymnasium instruction may obtain the same by the payment of the gymnasium fee in addition to their tuition. This will entitle the student to exercise with the regular classes, as well as to use the gymnasium at other times. The same condition is true of the Swimming Pool.

Requirements for Admission

Detailed information in regard to the requirements for admission to the courses of instruction in the School, will be found on succeeding pages. In general, the preparation necessary to enable an applicant to pursue one of the Courses, corresponds with that given by good high schools in their four-years' course.

Application for Admission

Each applicant for admission to the School is required to fill out an application blank, whereon he states his places of previous education, as well as the names of persons to whom reference may be made in regard to his character and previous training.

A deposit of five (5) dollars is required when the application is filed. Should the applicant be rejected, without being permitted to take the entrance examinations, one-half this fee will be returned to him. Should the application be approved, the fee will be retained to cover the cost of his registration, examinations, etc. This fee is non-returnable.

The last page of this catalog is in the form of an application blank, which may be detached and filled out to send in with the $5 matriculation fee.

Upon receipt of the application blank, properly filled out, together with the required deposit, the School at once looks up the applicant's references and high school records. When replies have been received to the various inquiries instituted, the applicant is at once advised as to his eligibility to admission to the School. All applicants must meet the Dean for a personal interview before being finally accepted by the School.

Preliminary Fee and First Tuition Payment

Should a student wish to be assigned to a position with a co-operating firm before the regular opening of School, he is required to fill out an attendance card and also an application for membership in the Association. A twenty-five (25) dollar fee, which is credited as part payment of tuition, must be paid before he will be assigned to any position at practical work. Once the student has been assigned to such a position, and has accepted it, this fee is non-returnable.

Before any student shall be allowed to attend classes, or be given supplies, he shall have made a total payment of sixty (60) dollars. This is entirely separate from the application fee of five (5) dollars.

Summing up the foregoing:

When a student applies for admission to the School, he makes a deposit of five dollars, which is not considered as part of the tuition, but is used to cover registration expenses. Of the hundred and twenty-five (125) dollar tuition, twenty-five (25) dollars must be paid before an applicant will be assigned a position at practical work, and an additional thirty-five (35) dollars, or in all sixty dollars, must be paid before a student will have books and supplies issued to him and be allowed to attend classes.

An application blank will be found just inside the back cover of this catalog. Fill it out in ink and mail it, together with the required five (5) dollar deposit, to H W. Geromanos, Dean, 316 Huntington Ave., Boston, Mass. Make all checks and money orders payable to the Boston Young Men's Christian Association.

School Year.

The term begins September 11, 1916, and on succeeding years the school year will commence on the second Monday in September. The school exercises are suspended on legal holidays and for one week at Christmas. The School closes at the end of the second week in June.

Attendance.

Students are expected to attend all exercises in the subjects they are studying, unless excused by the Dean. With the

exception of one hour in the middle of the day, exercises are held, and students are, in general, expected to devote themselves to the work of the school between 9 A. M. and 5 P. M. There are no exercises on Saturday after 1 P. M.

Books and Supplies

The student is furnished with all books, drawing instruments, slide rules and general supplies required for his work. This material is loaned to him during the school year, and must be returned in good condition, on demand, or else paid for.

No pens, pencils, notebooks, notebook paper, etc., are issued to the student, but the cost of these minor supplies should not run much over two dollars per year.

Birth and Educational Certificates

The passage of the recent law, by the Legislature, in regard to the hours and conditions of labor by minors, makes it necessary that all students under twenty-one years of age shall obtain Educational Certificates before they can be accepted by co-operating firms. For those students who plan to take the practical work, and who live outside of Boston, it will save time and trouble to bring a certificate of birth, or an Educational Certificate, with you on coming to Boston. The Educational Certificates are obtained free, upon request, from the Superintendent of Schools in the city or town where the student lives, if he lives in Massachusetts. For students living in other states a certificate of birth, or its equivalent, is all that will be necessary.

Status of Students

The ability of students to continue their courses is determined in part by means of examinations; but regularity of attendance and faithfulness to daily duties are considered equally essential.

Any student failing to make a satisfactory record, either in school or practical work, may be removed from his position in practical work, or from the School.

Examinations

Examinations in all subjects are held at the close of each school year, in May and June, and cover the work done during

the year. All students who maintain a year's average of 80 per cent, or over, in their daily work and informal examinations, in any subject, may be excused from the final examination in that subject, at the discretion of the instructor in charge, and with the approval of the Dean. When a final examination is taken the year's rating in the subject is based half on the examination and half on the record of the year's work.

Students will not be admitted to professional work in the several courses without satisfactory records in those previous subjects on which this work especially depends. That is, for illustration, a student cannot take Advanced Surveying until he has completed Elementary Surveying with a clear record.

Exceptions to this rule may be made in individual cases, after special consideration by the instructor in charge and the Dean.

Failure to take an examination at the proper time, unless excused, counts as a complete failure, and no other examination may be taken by the student in that subject, without special permission and a payment of five dollars for each examination.

Reports of Standing

Informal reports in all subjects are sent every two months, and formal reports covering the year's work are sent at the close of each year. These reports are sent to students, and to the parents, or guardians, of the students. Notification will be made to parents, or guardians, in all cases of students advised, or required, to withdraw, or placed on probation.

Owing to the short school year, it is of vital importance to the student that he get a clear record in all his work each week, and where a student fails to pass in any subject, a notification is sent to his parents, or guardian, to that effect, at the close of the week in which the failure was recorded, so that we may have the home influence exerted to bring his work up to a higher rating the next week.

Every effort is made to keep the student up in his studies, and parents and students are always gladly welcomed by the Dean for conference upon such questions. Special reports on a student's work will be sent to parents at any time, upon request.

Elective Subjects

Students electing any course, not included in their regular schedule, will be required to take all examinations in the subject, and to attain a passing grade before they will be eligible for the diploma of the School.

Conduct

It is assumed that students come to the School for a serious purpose, and that they will cheerfully conform to such regulations as may from time to time be made. In case of injury to any building, or to any of the furniture, apparatus or other property of the School, the damage will be charged to the student, or students, known to be immediately concerned; but if the persons who caused the damage are unknown, the cost of repairing the same may be assessed equally upon all the students of the School.

Students are expected to behave with decorum, to obey the regulations of the School, and to pay due respect to its officers. Conduct inconsistent with the general good order of the School, or persistent neglect of work, if repeated after admonition, may be followed by dismissal, or, in case the offense be a less serious one, the student may be placed upon probation. The student so placed upon probation may be dismissed if guilty of any further offense.

It is the aim so to administer the discipline of the School as to maintain a high standard of integrity and a scrupulous regard for truth. The attempt of any student to present, as his own, any work which he has not performed, or to pass any examination by improper means, is regarded as a most serious offense, and renders the offender liable to immediate expulsion. The aiding and abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Requirements for Graduation

To receive the diploma of the School the student must have attended the School not less than two years, which must be those immediately preceding his graduation, except as postponement may be specially permitted. He must have completed the prescribed studies of the four years, and must, also, pass final

examinations, if required, on subjects pertaining especially to his Course. In addition to this, he must have completed his period of practical work to the satisfaction of his employer.

The student must, also, prepare a thesis on some subject included in his course of study, or an account of some research made by him, or an original report upon some machine, work of engineering, or industrial plant. This thesis, or design, must be approved by the Dean. Theses are to be written on one side only of paper of good quality, 8 x 10½ inches in size, with an inch margin on each side. Theses must be handed to the Dean not later than the day on which the first annual examination occurs.

All theses, and records of work done in preparation of theses, are the permanent property of the School.

The diploma of the School represents not only the formal completion of the subjects in the selected course of study, but also the attainment of a satisfactory standard of general efficiency. Any student, who does not show in the fourth-year work of his Course, that he has attained such a standard, may be required, before receiving the diploma, to take such additional work as shall test his ability to reach that standard.

No diploma can be given until all dues to the School are discharged.

The diplomas awarded graduates will be signed by both the School authorities and the employers.

Students completing the school course, without being engaged in any practical work, will receive a special diploma.

Tuition Fees

A fee of five (5) dollars is to be paid when the application is filed, as a matriculation fee. This fee is non-returnable, if the applicant is permitted to take the entrance examinations. If he is rejected, without taking the examinations, one-half the deposit will be returned.

The tuition fee is $125 per year, and must be paid by entering students as follows:—

Twenty-five dollars preliminary fee (see previous page).

Thirty-five dollars additional, before receiving any supplies.

or,

Sixty dollars on, or before, attending classes and receiving supplies.

Thirty-five dollars December 1.

Thirty dollars March 1.

One-half the year's tuition will be charged any student who attends the School during six school weeks.

Any student whose application for entrance to the School, together with the required deposit of $5, was received on or before December 31, 1915, is entitled to the $110 rate of tuition.

Upper class students whose tuition rate is $110 shall pay it as follows:—

Forty dollars at beginning of fall term.

Forty dollars December 1.

Thirty dollars March 1.

Students who were enrolled in the School, when the tuition was increased from $100 to $110 per year, will be allowed to complete their course at the same rate of tuition that existed at the time of their entrance.

Such students shall pay their tuition as follows:—

Thirty dollars at beginning of fall term.

Forty dollars December 1.

Thirty dollars March 1.

Failure to make the required payments on time renders the student liable to be barred from his classes until the matter has been adjusted with the Bursar.

This tuition fee includes membership in the Association, as well as the use of all books, drawing instruments, etc., which are required in the school work. Such supplies as are required by the student for his school work, are loaned to him by the School, and must be returned on demand, in good condition, or else paid for.

Refunds

Students who are compelled, for any reason, to leave the School before the end of the school year, shall be charged at the rate of seven and one-half dollars per week for each week of school attendance, and in addition to this, shall be charged an extra twenty dollars over and above this weekly rate. The

date of withdrawal of any student shall be the day on which the School receives formal notice of his intentions to leave, at which time also all his supplies shall be returned, or paid for. No application for refunds will be considered until the student's supplies have all been returned, or paid for.

Laboratory Fees and Breakage

Beginning September, 1916, all students taking Chemical Laboratory work will be charged a nominal fee of $5 per year. Students will also be charged for all breakage and destruction of apparatus in all laboratories.

Payments

All payments should be made to Galen D. Light, Bursar.

Make checks payable to Boston Young Men's Christian Association.

Residence

For those students who will not be living at home, there are excellent accommodations, at very moderate rates, in the dormitories that are in our new building. These rooms may be had separately, or in groups with a common reception room, and the price varies from $1.50, or $2.00 per week, upwards. As board costs from $3.50 to $5.00 a week, a student could get room and board for from $5.00 a week to $6.00 per week.

The School officials have no authority in the matter of dormitory assignments. For rooms in the dormitories, write the House Secretary.

Location

The buildings are located on Huntington Avenue, just beyond Massachusetts Avenue, and are within easy access to the various railroad stations, and the business and residential sections, by electric cars.

Special Students

It is possible for students to enter the School and spend either every period at school, or else every other period at school, without being placed in practical employment. There will be extra charge under these conditions, if the student takes more

than two subjects above the regular schedule for the course and year for which he is entered.

A student obtaining a low rating on his entrance examinations, or who may not be eligible to assignment to practical work, for other reasons, may, by special permission, be allowed to attend school either every period or every alternate period, and, if his record for the year justifies it, may be assigned to practical work the following year.

Three-year Course

It has been found possible for students to attend school every week and to complete the course in three years. To do this, the student must have had a good high school education and cannot do the practical work in connection with the course.

Special permission to take a three-year course must be granted by the Faculty before a student will be permitted to enroll for such a course.

Students completing the course in three years will be required to pay the full tuition of the four-year course, namely, five hundred (500) dollars, before being awarded a diploma. The extra tuition shall be added to the regular tuition as follows:—

First year—Fifty dollars.
Second year—Fifty dollars.
Third year—Twenty-five dollars.

The dates on which the partial payments of these extra sums shall be payable are to be apportioned in any year on a proportional basis to the amounts due on the regular tuition.

The foregoing regulations do not apply to those students enrolled in the School before January, 1916.

Socials

In order to provide for the social intercourse of the students, as well as to enable the men in the different divisions to meet one another, socials and entertainments are held monthly for their exclusive enjoyment. An out-door field meet is also held yearly, at the close of the school year, at which time various interclass competitive games are enjoyed.

Vacations

The employers may allow our students one week's vacation at Christmas, and two weeks' vacation during the summer. They are not paid for this time. Whether a student shall have a full week at Christmas, or not, is at the option of the employer.

Summer Employment

When a student, for good reason, is unable to continue his practical work during the summer, while the School is not in session, it is sometimes possible to get him leave of absence for the summer so that he can return to his employer in the fall. All special arrangements for the summer work must be referred to the Dean.

Probation Period

When, for any reason, it is deemed advisable, the School reserves the right to place any entering student upon a period of probation, extending from one to three months, before placing him at practical work. Whether he shall be placed at work at the end of this time will be determined by the character of the work that he has accomplished during this probationary period.

Post-Graduate Opportunities

While the courses of the School have been carefully investigated by men who are recognized as authorities in their professions, who have pronounced the work to be of the grade and scope of good scientific schools, no degree is granted upon graduation.

For those who wish a degree, it may be obtained as follows:

By arranging a special schedule for the last two years of the Co-operative School course, and then putting in a full year in our School of Commerce and Finance, a student may get a valuable education in both Engineering and Accounting and qualify for the degree of B. C. S.

Students of good ability, on completing the Co-operative Engineering Course, have the opportunity to attend the Massachusetts Institute of Technology, if they care to, and by taking

special extra work in the Co-operative School during their course, they may reasonably expect to complete the Technology work and get their degree in two years. Through conference with the officials of the Institute, it has been found that those of our courses equivalent to theirs will probably be accepted in place of theirs, and the student given a clear record in such subjects, either by passing examinations, or at the discretion of the head of the Department. Since a large number of our courses are covering the same ground as those at the Institute, a capable student should be able at the end of his course to get a clear rating at Technology equivalent to at least two years' work there. This offers a rare opportunity for an ambitious, capable young man to get the most valuable kind of an education at small cost.

For further information about the School, write to

H. W. GEROMANOS, *Dean*,
316 Huntington Avenue,
Boston, Mass.

Requirements for Admission

IN GENERAL, the preparation necessary to enable an applicant to pursue successfully one of the regular courses, corresponds with that afforded by high schools of the better grade, offering a four-year course of study. Experience has shown that students who have not a complete high school course, or its equivalent, are severely handicapped in their work, so that such previous training is regarded as just as essential for entrance as the satisfactory passing of the required examinations.

In very exceptional cases a student who is not a high school graduate, may be allowed to enter as a special student, but only after his case has been passed on favorably by the Faculty and the Dean.

Every applicant must furnish references as to his character and ability, and must show cause why he may reasonably be expected to make a success of his course, both in the practical work and at the School. He must be willing and able to work hard, both mentally and physically.

For those unable to carry on the Engineering Courses owing to inadequate preliminary training, it has been found possible to plan special courses, of one or two years' duration, in the Preparatory School to fit for the Engineering School.

All applicants planning to take the examinations shall notify the Dean not less than ten days previous to the date of the examinations. For those students who may not be prepared to take the examinations in June, but who desire to work during the summer and then take the examinations in the fall, arrangements may be made by consultation with the Dean.

Any subjects not passed in the June examinations may be passed at the September examinations.

Applicants for admission to the Co-operative Engineering School are, in general, required to pass the entrance examinations of the School. Certificates of entrance examinations passed for admission to colleges, or technical schools of good standing, may be accepted in lieu of examinations.

The last page of this catalog is in the form of an application blank. It should be filled out in ink and forwarded, with the required five dollar deposit, to H. W. Geromanos, Dean, 316 Huntington Avenue, Boston, Mass. Make all checks and money orders payable to The Boston Young Men's Christian Association.

Admission to the First Year

The student intending to enter the School should bear in mind that the broader his intellectual training in any direction, and the more extensive his general acquirements, the greater will be the advantages he may expect to gain. The importance of thorough preparation in the subjects set for examination also is great, for the character and the amount of instruction given in the School, from the outset, leave little opportunity for one imperfectly fitted to make up deficiencies, and render it impossible for him to derive the full benefit from his course, or perhaps even to maintain his standing. The training given in the best high schools will, in general, afford suitable preparation.

The requirements of age and scholarship specified are regarded as a minimum in all ordinary cases, and only exceptional circumstances will justify any relaxation. Parents and guardians are advised that it is generally for the ultimate advantage of the student not to enter under the age of eighteen years.

Entrance Examinations in Boston

Examinations for admission to the first year class will be held at 316 Huntington Avenue on June 8 and 9, and on September 6 and 7, 1916.

Students are advised to attend the June examinations, if possible, in order that any deficiencies then existing may be made up in September, before entrance.

Examination Fees

Before taking the examination the applicant must have filed his application, together with the required five dollar deposit. If he gets a clear record in his examinations, he may pay the sixty (60) dollar first payment of his tuition fee, at any time before school opens. If, however, he wishes to start practical

work, he must pay the preliminary fee of twenty-five dollars before being assigned to a position.

Order of Examinations

Thursday, June 8, 1916.

10.00 A. M. to 12.00 N.	Algebra
1.00 P. M. to 3.00 P. M.	Plane Geometry

Friday, June 9, 1916.

10.00 A. M. to 12.00 N.	English
1.00 P. M. to 3.00 P. M.	Physics

No fees are to be paid at this time.

Subjects for Examination

To be admitted as a student to the first-year class, the applicant must have attained the age of seventeen years, and must have passed satisfactory examinations in the following subjects:—

Elementary Algebra.
Plane Geometry.
English.
Elementary Physics.

The examination in Physics is not required, but students not receiving a clear record in it, by examination or otherwise, will be required to take a special course in Physics, in addition to their regular first-year work.

The detailed requirements in the various subjects are as follows:—

Plane Geometry

The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas, regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

Algebra

The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including

complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one, or more, unknown quantities; problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative.

English

The examination in English will be as far as possible a test of the candidate's ability to express himself in writing in a manner at once clear and accurate.

The candidate will be required to write upon subjects familiar to him. His composition should be correct in spelling, punctuation, grammar, idiom and formation of paragraphs, and should be plain and natural in style. He will be judged by how well, rather than by how much he writes.

Physics

The candidate will be expected to be familiar with the fundamental principles of Physics. It is especially desirable that he should have a good knowledge of general mechanics and of the mechanics of solids, liquids and gases. A knowledge of physical hypotheses is comparatively unimportant. Text-book instruction should be supplemented by lecture-room experiments. A sufficiently extended treatment of the subject will be found in any of the principal text-books now in use in secondary schools. Ability to solve simple problems will be expected.

Students presenting laboratory notebooks in Physics, properly endorsed, will be allowed 10 per cent on the examination rating, for such books as are accepted. That is, an accepted notebook adds 10 per cent to whatever rating is obtained on the written examination up to 100 per cent.

Arithmetic

The requirement in Arithmetic for entrance has been waived.

Admission by Certificates

Students presenting certificates from a preparatory school, which has the certification privilege, in any, or all, subjects required for entrance, may be given credit in those subjects,

without an examination, upon application to the Dean. Such applications, together with a certificate from the principal, or instructor, stating the work done and the ranks received, shall be filed with the Dean, not less than ten days preceding the examination date.

The right is reserved to require any applicant to take the Entrance Examinations, without regard to such certification, should it be deemed necessary.

Conditions

A candidate failing in only one or two of the examination subjects, may be admitted with "conditions." A candidate incurring conditions in June must repeat, in September, examinations in those subjects in which he has failed.

In any case of a condition existing after a second examination in a subject, special arrangements must be made with the Dean before a student will be allowed to attend classes.

Modern Languages

There is no requirement in the modern languages for entrance to the School, and students who desire to take up these subjects during their course may do so, provided they show the capacity to handle such work in addition to the required subjects.

Outlines of Subjects Required for Entrance

By writing the Dean, prospective applicants may receive a brief outline covering the subjects in Physics and Algebra upon which the Entrance Examinations are based. These outlines are issued in order that the applicant may concentrate his study upon subjects that are essential to the work, and not spread his efforts over too large a field.

Courses of Study

General Information

THE SCHEDULES of the various courses are given on the following pages. The first-year work of all courses is practically the same, with a few exceptions, which are made because of the need of the student for elementary training in his professional subjects. This is done so that he may gain more from his early practical work, as well as be of more use to his employer by reason of a better understanding of the duties he may be called upon to perform.

The school year comprises eighteen weeks of class work, and one week of examinations for each division. The eighteen weeks are divided into two terms of nine weeks each, and the subjects in the Course Outlines on the following pages have been arranged by terms. Opposite these subjects will be found the number of hours of class work in recitation, laboratory or the drawing room, as well as the hours of outside preparation that have been assigned as the minimum weekly required amount for each subject.

The number in parenthesis, following the subject in the "Outlines of Courses," is the number by which that subject is identified in the descriptive matter under "Subjects of Instruction."

The work is so planned that the student will be required to spend from 50 to 60 hours in preparation and class work during each school week.

When a student elects a Course, he is required to complete all subjects in that Course, not indicated as "Optional," in order to receive a diploma. No subject is to be dropped, or omitted, without the consent of the Dean.

Civil Engineering

The purpose of this Course is to give the student a broad education in those subjects which form the basis of all branches of technical education, and a special training in those subjects comprised under the term "Civil Engineering." It is designed to give the student sound training, both theoretical and practical, in the sciences upon which professional practice is based.

Civil Engineering covers such a broad field that no one can become expert in its whole extent. It includes Topographical Engineering, Municipal Engineering, Railroad Engineering, Structural Engineering, and Hydraulic and Sanitary Engineering. It covers land surveying, the building of railroads, harbors, docks and similar structures; the construction of sewers, waterworks, roads and streets; the design and construction of girders, roofs, trusses, bridges, buildings, walls, foundations and all fixed structures. All of these branches of Engineering rest, however, upon a relatively compact body of principles, and in these principles the students are trained by practice in the class room, drawing room, the field and the testing laboratory.

The course is designed to prepare the young engineer to take up the work of assisting in the design and construction of structures; to aid in the location and construction of steam and electric railways, sewerage and water supply systems; and to undertake intelligently supervision of work in the allied fields of mining, architectural and electrical engineering, and general contracting.

I.—Civil Engineering

FIRST YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Mathematics I. (10)	5	5	Mathematics I. (10)	5	5
Physics I., Lect. and Rec. (20)	4	4	Physics I., Lect. and Rec. (20)	4	4
Physics I., Laboratory (21)	2	2	Physics I., Laboratory (21)	2	2
Descriptive Geometry I. (42)	4	1	Descriptive Geometry I. (42)	4	1
Mechanical Drawing (40)	6	0	Mechanical Drawing (40)	6	0
Engineering Computations (14)	2	0	Engineering Computations(14)	2	0
English I. (1)	3	3	English I. (1)	3	3
Surveying I. (50)	2	2	Surveying I. (50)	2	2
Surveying I.,Field and Plot(51)	6	0	Surveying I.,Field and Plot(51)	6	0

SECOND YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Surveying II. (52)	2	2	Surveying II. (52)	2	2
Surveying II., Field & Plot (53)	6	0	Surveying II., Field & Plot(53)	6	0
*Topographical Drawing (54)	2	0	*Topographical Drawing (54)	2	0
Applied Mechanics I. (30)	3	4½	Applied Mechanics I. (30)	3	4½
Physics II., Lect. and Rec. (22)	3	3	Physics II., Lect. and Rec. (22)	3	3
Physics II., Laboratory (23)	2	2	Physics II., Laboratory (23)	2	2
Mathematics II. (11)	4	6	Mathematics II. (11)	4	6
Elementary Electricity (126)	2	2	Elementary Electricity (126)	2	2
Descriptive Geometry II. (43)	2	0	Descriptive Geometry II. (43)	2	0
Mechanism (90)	3	3	Valve Gears (90)	1	2
			Precision of Measurements (13)	1	1

THIRD YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Railroad Engineering (57)	3	4½	Railroad Engineering (57)	3	4½
Railroad Eng.Field & Draw.(58)	6	0	Railroad Eng.Field & Draw.(58)	6	0
Mathematics III. (12)	2	2	Theory of Structures (70)	3	4½
Structural Drawing (73)	2	0	Structural Drawing (73)	2	0
Highway Engineering (56)	1	1	Highway Engineering (56)	1	1
Materials (81)	2	2	Materials (81)	2	2
Applied Mechanics II. (31)	3	4½	Applied Mechanics II. (31)	3	4½
Hydraulics (110)	2	3	Hydraulics (110)	2	3
Practical Electricity L.&R.(134)	2	2	Practical Electricity L.&R.(134)	2	2
Practical Electricity Lab.(135)	3	2	Practical Electricity Lab. (135)	3	2
Dynamical and Struct.Geol.(160)	2	2			

FOURTH YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Structural Design (74)	6	0	Structural Design (74)	6	0
Theory of Structures (71)	5	10	Theory of Structures (71)	5	10
Advanced Structures (72)	2	2	Advanced Structures (72)	2	2
†Concrete Construction (80)	2	2	†Concrete Construction (80)	2	2
Concrete Design (80A)	3	0	Concrete Design (80A)	3	0
‡Foundations (82)	1	1	‡Foundations (82)	1	1
Hydraulic & Sanitary Eng.(112)	3	3	Hydraulic & Sanitary Eng.(112)	2	2
Heat Engineering: Thermo.(95)	3	4½	Heat Engineering: Thermo.(95)	3	4½
Hydraulic Motors (Optional) (111)	2	3	Hydraulic Motors (Optional) (111)	2	3
Thesis	3	0	Testing Materials Lab. (34)	2	0
			Thesis	6	0

* Structural Drawing (73) will be given instead of Topograpical Drawing (54).
† Materials (81) will be given instead of Concrete Construction (80).
‡ Highway Engineering (56) will be given instead of Foundations (82).

Mechanical Engineering

This Course is designed to give a broad foundation in those fundamental subjects which form the basis for all professional engineering practice, and to especially equip the young engineer with a thorough knowledge of the various phases of Mechanical Engineering. The Course embraces instruction by text-book, lecture, laboratory and work-shop practice, with special references to the following branches: Steam Engineering, Hydraulic Engineering, Power Plant Design, Machine Design, Applied Electricity, Heat Engineering, and allied fields of the engineering profession.

The Course affords training in the methods, and gives practice in the process of Construction, which develops in the student the capacity for thinking along mechanical lines, thus enabling him to base all of his work upon fundamental principles already learned, rather than upon empirical rules. It is the endeavor to give the student a thorough theoretical training and meanwhile devote sufficient time to the practical work, so that he may become a proficient mechanical engineer, both in theory and in practice, in all of the various branches of Mechanical Engineering previously mentioned.

II.—Mechanical Engineering

FIRST YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Mathematics I. (10)	5	5	Mathematics I. (10)	5	5
Physics I., Lect. and Rec. (20)	4	4	Physics I., Lect. and Rec. (20)	4	4
Physics I., Laboratory (21)	2	2	Physics I., Laboratory (21)	2	2
Descriptive Geometry I. (42)	4	1	Descriptive Geometry I. (42)	4	1
Mechanical Drawing (40)	12	0	Mechanical Drawing (40)	12	0
Engineering Computations (14)	2	0	Engineering Computations (14)	2	0
English I. (1)	3	3	English I. (1)	3	3

SECOND YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Mechanism (90)	3	3	Mechanism (90)	3	3
Mechanical Eng. Drawing (91)	9	0	Mechanical Eng. Drawing (91)	9	0
Descriptive Geometry II. (43)	2	0	Descriptive Geometry II. (43)	2	0
Mathematics II. (11)	4	6	Mathematics II. (11)	4	6
Physics II., Lect. and Rec. (22)	3	3	Physics II., Lect. and Rec. (22)	3	3
Physics II., Laboratory (23)	2	2	Physics II., Laboratory (23)	2	2
Applied Mechanics I. (30)	3	4½	Applied Mechanics I. (30)	3	4½
Elements of Electricity (126)	2	2	Elements of Electricity (126)	2	2
			Precision of Measurements (13)	1	1
			Valve Gears (90)	1	2

THIRD YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Heat Engineering: Thermo. (95)	3	4½	Heat Engineering: Thermo. (95)	3	4½
Boilers (95)	2	1	Boilers (95)	2	1
Applied Mechanics II. (31)	3	4½	Applied Mechanics II. (31)	3	4½
Machine Drawing (92)	9	0	Machine Drawing (92)	9	0
Materials (81)	2	2	Materials (81)	2	2
Hydraulics (110)	2	3	Hydraulics (110)	2	3
Practical Electricity Lect. (134)	2	2	Practical Electricity Lect. (134)	2	2
Practical Electricity Lab. (135)	3	2	Practical Electricity Lab. (135)	3	2
Mathematics III. (12)	2	2	General Metallurgy (147)	2	1
			Foundry Practice (99)	1	0

FOURTH YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Machine Design, Statics and Dynamics (93)	12	3	Machine Design, Statics and Dynamics (93)	12	3
Applied Mechanics III. (33)	2	2	Testing Materials Lab. (34)	2	0
Engineering Laboratory (97)	3	0	‡Engineering Laboratory (97)	3	0
Hydraulic Motors (111)	2	3	Hydraulic Motors (111)	2	3
Power Plant Design (96)	3	0	Power Plant Design (96)	3	0
*Concrete Construction (80)	2	2	*Concrete Construction (80)	2	2
†Factory Construction and Management (104)	3	0	†Factory Construction and Management (104)	4	0
Boiler Design (100)	3	0	§Surveying I., A (50A)	3	0
Journals and Reports (105)	1	3	Journals and Reports (105)	1	3
Illumination & Photometry (132)	2	2	Thesis	6	3
Thesis	3	3	Machine Work (103) (Elective)	3	0
Machine Work (103) (Elective)	3	0	Forging, Chipping and Filing (101) (Elective)	2	0
Forging, Chipping and Filing (101) (Elective)	2	0	Woodworking and Pattern Making (102) (Elective)	3	0
Woodworking and Pattern Making (102) (Elective)	3	0			

*Alternates with Materials. Not given in 1917.
†Not given in 1917.
‡First three weeks only.
§For three weeks only.

Electrical Engineering

Electrical Engineering having in recent years developed along lines demanding a thorough appreciation of physical theory, as well as a broad working knowledge of Mathematics, it is essential that students planning to take this Course should realize the fundamental necessity of obtaining a solid grounding in these subjects upon which to build.

It is not the purpose of the Course to attempt the impossible aim of turning out fully trained engineers in the various branches of the science, especially as it is becoming daily more and more differentiated and specialized; but rather to lay a broad and thorough foundation for future progress along the lines of work which may particularly appeal to the individual, by giving him a good working acquaintance with the essential principles which underlie each of the more specialized branches of professional activity. Parallel with the theoretical work, runs a carefully planned course of laboratory work which is intended to develop the student's powers of accurate observation, of planning work and methods for himself, with due regard to saving of time and precision of results. For more detailed matters the reader is referred to the description of the several courses and subjects of instruction.

III.—Electrical Engineering

FIRST YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Mathematics I. (10)	5	5	Mathematics I. (10)	5	5
Physics I., Lect. and Rec. (20)	4	4	Physics I., Lect. and Rec. (20)	4	4
Physics I., Laboratory (21)	2	2	Physics I., Laboratory (21)	2	2
Elements of Electricity (126)	2	2	Elements of Electricity (126)	2	2
Descriptive Geometry I. (42)	4	1	Descriptive Geometry I. (42)	4	1
Mechanical Drawing (40)	12	0	Mechanical Drawing (40)	12	0
English I. (1)	3	3	English I. (1)	3	3
Engineering Computations (14)	2	0	Engineering Computations (14)	2	0

SECOND YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Direct Current Machinery (129)	2	2	Direct Current Practice (129)	2	2
Electrical Problems (125)	2	1	Electrical Problems (125)	2	1
Elec. Eng. I., Lab. and Reports (112A)	5	0	Elec. Eng. I., Lab. and Reports (112A)	5	0
Mathematics II. (11)	4	6	Mathematics II. (11)	4	6
Physics II. Lect. and Rec. (22)	3	3	Physics II., Lect. and Rec. (22)	3	3
†Physics II., Laboratory (23) †Elementary Elec. Lab. (124)	2	2	†Physics II., Laboratory (23) †Elementary Elec. Lab. (124)	2	2
Applied Mechanics I. (30)	3	4½	Applied Mechanics I. (30)	3	4½
Mechanism (90)	3	3	*Mechanism (90)	3	3
Mechanical Eng. Drawing (91)	3	0	‡Technical Elect. Meas. Lect. (130A)	2	2
			Precision of Measurements (13)	1	1
			Valve Gears (90)	1	2
			Mechanical Eng. Drawing (91)	3	0

THIRD YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Alternating Currents, Lect., Rec. and Problems (138)	4	4	Alternating Current Machinery, Lect. Rec., and Problems (139)	7	7
Technical Elect. Meas. Lect. (130A)	2	1	Elect. Eng. II., Lab. (122B)	5	2
Elect. Eng. II., Lab. (122B)	5	2	Tech. Elect. Meas. Lab. (130B)	5	2
Tech. Elect. Meas. Lab. (130B)	5	2	Variable Currents (131)	1	1
Variable Currents (131)	2	2	General Metallurgy (147)	2	1
Mathematics III. (12)	2	2	Heat Eng.: Thermo. (95)	3	4½
Heat Eng.: Thermo. (95)	3	4½	Machine Drawing (92)	6	0
Applied Mechanics II. (31)	3	4½	Hydraulics (110)	2	3
Hydraulics (110)	2	3			

FOURTH YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Alternating Current Machinery Lect., Rec. and Problems (139)	4	4	Gen. Probs. in Elect. Eng. (136)	2	2
Alternating Current Machinery Lab. (139A)	5	5	Electric Railways (133)	2	2
Illumination and Photometry (132)	2	2	Alternating Current Machinery Lab. (139A)	5	5
Elect. Transmission of Power (120)	2	2	Central Stations (121)	1	1
Central Stations (121)	1	1	Tech. Papers and Magazines (137A)	1	3
Tech. Papers and Magazines (137A)	1	3	Elect. Eng. Excursions (121A) Journals (137)	2	1
Elect. Eng. Excursions (121A) Journals (137)	2	1	Testing Materials Lab. (34)	2	0
Hydraulic Motors (111)	2	3	Hydraulic Motors (111)	2	3
Engineering Laboratory (97)	3	0	Theoretical Electricity (127)	2	2
§Surveying I. A (50A)	3	0	*Engineering Laboratory (97)	3	0
Thesis	4	0	Thesis	12	0

* First three weeks of second term.
† These subjects alternate every other week.
‡ Last six weeks of second term.
§ First three weeks only.

Chemical Engineering

During the great industrial advance of recent years, chemical industry has been in the front rank of progress, and perhaps the most potent reason for this may be found in the replacement, by scientific guidance, of the old rule of thumb methods.

Again, owing to the keenest competition, manufacturers have been compelled to utilize every product of their plants, and this has called for skilled chemical knowledge.

The Course in Chemical Engineering has, for its purpose, the training of students competent to take responsible places in the operation of industries based on chemical principles.

During their course the students are employed in chemical industries, as gas manufacturing plants, chemical engineering companies, etc., so that they not only get an excellent training in the theory of such work at school, but get a thorough familiarity with the technical side of the industry as well.

The class work includes a training in Inorganic, Analytical, Organic, and Industrial Chemistry, which is accompanied by appropriate laboratory work.

In addition to the foregoing subjects, the student is given a good knowledge of mechanical and electrical subjects, as Drawing, Applied Mechanics, Direct Current Practice, Technical Electrical Measurements, etc., which are taken up in a way to give them especial bearing on the work of the Course.

IV.—Chemical Engineering

FIRST YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Mathematics I. (10)	5	5	Mathematics I. (10)	5	5
Physics I., Lect. and Rec. (20)	4	4	Physics I., Lect. and Rec. (20)	4	4
Physics I., Laboratory (21)	2	2	Physics I., Laboratory (21)	2	2
Descriptive Geometry I. (42)	4	1	Descriptive Geometry I. (42)	4	1
Mechanical Drawing (40)	3	0	Mechanical Drawing (40)	3	0
Engineering Computations (14)	2	0	Engineering Computations (14)	2	0
English I. (1)	3	3	English I. (1)	3	3
Inorganic Chemistry (142)	4	4	Inorganic Chemistry (142)	4	4
Inorganic Chemistry Lab. (142)	6	0	Inorganic Chemistry Lab. (142)	6	0

SECOND YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Qualitative Analysis (143)	12	3	Quantitative Analysis (144)	12	3
Mathematics II. (11)	4	6	Mathematics II. (11)	4	6
Physics II., Lect. and Rec. (22)	3	3	Physics II., Lect. and Rec. (22)	3	3
Physics II., Laboratory (23)	2	2	Physics II., Laboratory (23)	2	2
Applied Mechanics I. (30)	3	4½	Applied Mechanics I. (30)	3	4½
Mechanical Eng. Drawing (91)	3	0	Mechanical Eng. Drawing (91)	3	0
Mechanism (90)	3	3	*Mechanism (90)	3	3
Elements of Electricity (126)	2	2	Elements of Electricity (126)	2	2
			Valve Gears (90)	1	2

THIRD YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Organic Chemistry Lect. (145)	3	3	Organic Chemistry Lect. (145)	3	3
Organic Chemistry Lab. (145A)	6	0	Organic Chemistry Lab. (145A)	6	0
Mathematics III. (12)	2	2	General Metallurgy (147)	2	2
Applied Mechanics II. (31)	3	4½	Technical Analysis (148)	3	1
Heat Engineering: Thermo. (95)	3	4½	Heat Engineering: Thermo. (95)	3	4½
Machine Drawing (92)	3	0	Machine Drawing (92)	3	0
Practical Electricity Lect. (134)	2	2	Practical Electricity Lect. (134)	2	2
Practical Electricity Lab. (135)	3	2	Practical Electricity Lab. (135)	3	2
Hydraulics (110)	2	3	Hydraulics (110)	2	3
German I. (170)	2	2	German I. (170)	2	2
			Theoretical Chemistry Lect.(149)	2	2

FOURTH YEAR

FIRST TERM	Hours per Week Ex.	Prep.	SECOND TERM	Hours per Week Ex.	Prep.
Technical Analysis (148)	4	2	Technical Analysis (148)	4	2
Industrial Chemistry Lect. (146)	3	3	Industrial Chemistry Lect. (146)	3	3
Industrial Chemistry Lab. (146A)	6	0	Industrial Chemistry Lab. (146A)	6	0
Organic Chemistry Lect. (145)	2	2	Organic Chemistry Lect. (145)	2	2
Organic Chemistry Lab. (145A)	6	0	Organic Chemistry Lab. (145A)	6	0
Chemical Engineering (150)	3	3	Chemical Engineering (150)	3	3
Theoretical Chemistry Lect.(149)	3	3	Factory Inspection and Report Writing (151)	3	2
Theoretical Chemistry Lab. (149A)	3	0	German II. (171)	2	2
German II. (171)	3	3	Thesis	6	3
Thesis	3	3			

* First three weeks only.

Subjects for Instruction

INSTRUCTION is given by lectures and recitations, and by practical exercises in the field, the laboratories, and the drawing rooms. A great value is set upon the educational effect of these exercises, and they form the foundation of each of the four courses. Text-books are used in many subjects, but not in all. In many branches the instruction given differs widely from available text-books ; and, in most of such cases, notes on the lectures and laboratory work are issued, and are furnished to the students. Besides oral examinations in connection with the ordinary exercises, written examinations are held from time to time. At the close of the year, in May and June, general examinations are held.

In the following pages will be found a more or less detailed statement of the scope, as well as the method of instruction, of the subjects offered in the various Courses. The subjects are classified, as far as possible, related studies being arranged in sequence.

The subjects are numbered, or numbered and lettered, for convenience of reference in consulting the various Course Schedules. As the total number of hours per term devoted to a subject sometimes varies in different Courses, these hours are not in every case given in connection with the following descriptions.

The requisites for preparation include not only the subjects specified by number, but also those required as a preparation for them. The reason for this is that to properly carry on the more advanced subjects, the student must have become proficient in all subjects necessary for a clear comprehension of the last subject. Some studies, specified as being required in preparation, may be taken simultaneously. The student must complete such subjects before starting on more advanced work.

By careful consideration of the Course Schedules, in connection with the following Description of Subjects, the applicant for a special Course may select, for the earlier part of that Course, such subjects as will enable him to pursue later those more advanced subjects which he may particularly desire.

Applications for exception, for sufficient causes, from the required preparation, as stated in connection with each subject described below, will always be considered by the Dean.

The topics, included in the list which follows, are subject to change at any time by action of the School authorities.

Synopsis of Courses

1. English I.

This is a course in the principles of composition and letter writing. Special attention is given to spelling, punctuation and grammar.

The latter half of the work is devoted to writing business letters, to descriptions of processes and machinery, and to all other possible means of enabling the student to express himself with accuracy and precision, both orally and in writing.

10. Mathematics I.

Preparation: Algebra, Geometry

Variation, logarithms, slide rule, exponential equations, the uses of formulas in Physics and Engineering.

Trigonometry, including circular measure, co-ordinates, trigonometric ratios, formulas, law of sines, law of cosines, solution of right and oblique triangles and applications to problems in Physics and Engineering.

11. Mathematics II.

Preparation: 10

Co-ordinates, plotting of functions, interpolation, the straight line, curves represented by various equations, graphic solution of equations, determination of laws from the data of experiments. Rate of increase, differentiation, determination of maxima and minima by differentiation, integration, definite integrals, determination of mean value, area and volume by integration, center of gravity, moment of inertia, partial differentiation.

12. Mathematics III.

Preparation: 10, 11

A review and continuation of Mathematics II. The consideration of Differential and Integral Calculus, as applied to problems in Engineering.

13. Precision of Measurements

Preparation: 10, 11

This course, which is required of all students in the second half of the second year, comprises a thorough discussion of the fundamentals of the Theory of Measurements, including a study of the Sources of Error, the Best Representative Value of the result of a series of measurements, the determination of the several Precision Measures of the result of one's work, the converse problem of how best to proceed in order to reach a given degree of precision, and a thorough consideration of the proper use of Significant Figures.

14. Engineering Computations

This course is taken by all first-year students and is an unprepared exercise coming two hours per week throughout the first year. The work covers arithmetical computations of the various kinds common to engineering practice, such as addition, subtraction, division and multiplication of whole and mixed numbers, problems in the use of fractions, percentage calculations, square root, etc.

19. Review Mathematics

This course is given in the first year to those students who have had inadequate mathematical training previous to entering the School. The work covers Algebra and Geometry and aims to strengthen the student on his weak points. Students whose records in Mathematics I. are not satisfactory may be required to take this course.

20. Physics I.

The subjects considered are general mechanics, molecular mechanics, wave-motion and optics, which topics are discussed both mathematically and experimentally. It is the purpose of the course to lay a thorough foundation for subsequent study of experimental and technical physics. Hence it is planned with immediate reference to familiarizing the pupil with the fundamental principles of the science. The lectures are illustrated by suitable experiments.

21. Physical Laboratory I.

Preparation: 20

A course of experimental exercises in the first year, laid out individually for each student. The experiments are correlated, so far as practical, with the lecture and class-room work, the first year being devoted to experiments in mechanics. The use of the various instruments of precision is taught, as far as may be, in connection with experiments, each of which illustrates some different method or principle. The experiments relate to the mechanics of solids, liquids, and gases.

22. Physics II.

Preparation: 20

A course of experimental lectures, which is a continuation of Physics I. In this work the student completes the study of physics started in Physics I.

23. Physical Laboratory II.

Preparation: 22

A series of experiments in the second year, correlated as far as practicable with the lecture course. The experiments in Optics include the use of a compound microscope, the determination of the focal length of lenses, gas photometry, indices of refraction, and elementary spectrum analysis. All work is strictly quantitative, and the attention of the student is especially directed to the precision discussion of his results.

29. Review Physics

A course covering the essentials of Physics as taught in the best high schools, and designed to help those students who have had insufficient preparation before entering the Engineering School. Students whose records in Physics I. are unsatisfactory may be required to take this course in addition to their other work.

30. Applied Mechanics I.

Preparation: 10, 11, 20, 22

The course comprises a study of the general methods and applications of statics, including the determination of reactions, stresses in frames; of distributed forces, center of gravity; of moment of inertia and radius of gyration of plane areas and

solids. Kinematics and dynamics are also included in this course, together with the equations for uniform and varying rectilinear and curvilinear motion, centrifugal force, pendulum, harmonic motion, rotation, combined rotation and translation, momentum and angular momentum, center of percussion, impact, work, power and kinetic energy.

31. Applied Mechanics II.

Preparation : 30

This course comprises a study of the strength of materials, mathematically treated. In the first term the subjects studied are : the stresses and strains in bodies subjected to tension, to compression and to shearing ; common theory of beams, with thorough discussion of the distribution of stresses, shearing forces and bending moments ; longitudinal shear, slopes and deflections, and the strength of shafts and springs. In the second term a study is made of the combined stresses in beams subjected to tension and compression, as well as bending ; also of the strength of hooks and columns, the design of riveted joints and thin, hollow cylinders. A brief consideration of strains, and the relations of the stresses on different planes in a body, and the stresses in simple frames subjected to bending forces, is taken up in the latter part of the course.

33. Applied Mechanics III.

Preparation : 31

A course treating of the laws of friction, including a study of the distribution of friction on shaft journals and pivots ; also a study of the transmission of power by belting and by ropes, and of the friction reducing power of lubricating oils.

34. Testing Materials Laboratory

Preparation : 31

The work done by the students in the Testing Materials Laboratory includes tests to determine the modulus of elasticity, limit of elasticity, yield point and tensile strength of steel bars ; tests of the deflection and of the transverse strength of a wooden beam subjected to a transverse load ; tests to determine the modulus of elasticity and tensile strength of wire ; tests on cement mortars, including practice in laboratory methods.

40. Mechanical Drawing

This course extends throughout the first year, and is taken by all first-year students. The work is planned on the assumption that the student has had no experience in the use of drafting instruments, and so at the start he is taught the mechanical processes involved in the use of the various instruments. Then he takes up line work, use of French curve, geometrical constructions, tracing and simple projection work.

A student who has completed work equivalent to the course before entering the School may, upon presentation of his plates and the passing of a satisfactory examination, be excused from the work at the discretion of the instructor in charge.

42. Descriptive Geometry I.

The course covers the simpler problems on the point, line and plane and various constructions in the projection of solids, including sections and developments.

In the latter half of the course the problems on the line and plane are completed, and the projection of solids is continued through the intersection of solids bounded by plane faces. Isometric drawings and several practical applications are given.

43. Descriptive Geometry II.

Preparation : 42

The course is a continuation of Descriptive Geometry I., and deals with single and double curved surfaces; their intersection by oblique planes, tangent planes, penetrations, development, and so forth. Various practical problems are given to illustrate the applications of the principles studied.

50. Surveying I.

Preparation : 10, 11

This course consists of two lectures or recitations per week during the first year. The student is taught the theory of the various instruments used in plane surveying, the methods of carrying out various surveys, and the application of contour maps to the solution of problems of drainage, road location, landscape engineering, etc. The text-book used is *The Principles and Practice of Surveying*, by Professors Breed and Hosmer, Vol. I.

50A. Surveying I A.

This is a brief course for students taking Courses II. and III. to give them instruction in the essential principles of surveying practice.

51. Surveying I. (Fieldwork and Plotting)

Preparation : 50

This course is taken simultaneously with Surveying I., and consists of six hours of exercise per week throughout the year. The student is taught the use of the chain, tape, compass, transit and various forms of leveling instruments. The work in the drawing room consists in making the computations which arise in the work of a surveyor and in making scale drawings by the methods in common use.

52. Surveying II.

Preparation : 50, 51

This course is a continuation of Surveying I., and consists of two lectures, or recitations, per week throughout the second year. The student is taught the theory of the stadia and plane table in topographic surveying, the methods of making astronomical observations and of conducting city and photographic surveys. The text-books used are *The Principles and Practice of Surveying*, by Professors Breed and Hosmer, Vols. I. and II.

53. Surveying II. (Fieldwork and Plotting)

Preparation : 52

This course is taken simultaneously with Surveying II., and consists of six hours of exercise per week throughout the second year. A stadia survey is first made, and later a topographical map made from the notes taken in the field. The practice of plane table surveying, the determination of elevations by barometer, and the conduct of photographic surveys are also studied.

54. Topographical Drawing

Preparation : 50, 52

This course consists of two hours of exercise per week throughout the year. A study is made of the different topographical signs used on surveying maps, both in pen and ink and in wash color. Each student is required to make a number of plates of each kind of topography, and to become reasonably proficient in the making of topographical maps.

56. Highway Engineering

Preparation : 57

This course consists of one lecture or recitation a week throughout the year. A study is made of the principles governing the location, construction and maintenance of roads and the construction and maintenance of the various kinds of pavements for city streets. The text-book used is Baker's work on Roads and Pavements.

57. Railroad Engineering

Preparation : 50, 51, 58

This course consists of three hours of exercise a week throughout the year. A study is made of the mathematics of the various curves used in engineering, with their application to the location of railroads, highways, sewers, pipe lines, etc. The easement curve is also studied, and the various methods of staking out and computing earthwork. The text-books used are Professor Allen's *Railroad Curves and Earthwork*, and his *Field and Office Tables.*

58. Railroad Fieldwork and Drawing

Preparation : 57

This course consists of six hours of exercise a week throughout the year. A reconnoissance is first made of a railroad about a mile and a half in length, followed by a preliminary survey with transit and level for the determination of contours, as a basis for fixing the location survey. All this work follows modern practice in laying out railroads. The greater part of the fieldwork is devoted to a systematic drill in running in curves of various kinds, including transition curves, and in staking out fieldwork. The drawing consists in plotting up the preliminary survey of the railroad surveyed.

70. Theory of Structures

Preparation : 31

This is a course of thirty exercises in the third year, devoted to class and drawing-room work in studying the loads, reactions, shears and moments acting upon structures of various kinds as roofs and bridges. A thorough study is also made of the various functions of the influence line and the methods used to determine the position of moving loads to produce maximum shears

and moments on bridges. The text-book used is Professor Spofford's *Theory of Structures.* A study is also made of the practical design of beams and girders.

71. Theory of Structures, Bridges and Similar Structures
Preparation : 70

This course treats of the computation and design of structures of wood, steel and masonry, by analytical and by graphical methods. The subjects considered are : the plate girder, roof and bridge trusses of various types ; such as simple trusses, bridge trusses with secondary web systems, including the Baltimore and Pettit Trusses, and trusses with multiple web systems, lateral and portal bracing, transverse bents, viaduct towers and cantilever bridges. A study is also made of the design of columns, tension members, pin and riveted truss joints, trestles of wood and steel, and arches of metal and stone. In the latter part of the course the student is given training in the use of the standard handbooks in structural work. The object is to train the student thoroughly in the application of mechanics to the design of structures. The text-book used is Professor Spofford's *Theory of Structures.*

72. Advanced Structures
Preparation : 71

This course consists of a thorough study of graphical statics, deflection and camber, and continuous girders, after which it treats of the computation and design of retaining walls, masonry dams, masonry arches, continuous girders, and movable bridges. Only the more simple cases are considered.

73. Structural Drawing

The course in structural drawing consists of one exercise of two hours each week throughout the third year in the drawing room, devoted to the drawing of standard sections of structural steel shapes and connections, and the preparation of drawings representing elementary structural details. This course is designed to familiarize the student with the conventional signs for riveting, riveted connections and the dimensioning and detailing of structural parts.

74. Structural Design

Preparation: 72

A course of six hours per week throughout the fourth year, in which the students are instructed in the design of structures of wood, stone and metal. Each student is given a set of data, and is required to perform all the computations and to make designs and working drawings for structures, such as plate girder bridges and wooden roof trusses. His work is criticized as it progresses.

80. Concrete Construction

Preparation: 72

A course consisting of lectures and drafting, in which instruction is given in the theoretical and practical principles involved in the design of structures of plain and reinforced concrete. The course includes a study of the simple reinforced concrete beam, the design of slabs, T-beams, columns and footings. Instruction is given by means of lectures and text-books, in conjunction with which each student is given practical problems in design to be worked out in the drawing room.

80A. Concrete Design

A course of three hours per week throughout the fourth year, in which students are given instruction in the design of structures of concrete, plain and reinforced. Each student is given a set of data, and is required to make all computations and to make designs and working drawings for several concrete structures, including a masonry dam, plain concrete arch, a reinforced concrete floor system, and a reinforced concrete retaining wall.

81. Materials

Preparation: 72

This course consists of two lectures, or recitations, per week throughout the third year, in the study of the methods of manufacturing, properties and strength of various materials used by the engineer, such as brick, cement, concrete, iron and steel. A study is also made of the properties of wood and stone. The text-book used is Johnson's *The Materials of Construction.*

82. Foundations

Preparation: 71

A course of eighteen lectures during the fourth year. The subjects treated in this course are as follows: Building stones and concrete, bearing power of different kinds of soil, examination of the site, designing the footings, whether of masonry or of steel and concrete, independent piers, pile foundations, compressed air processes, freezing processes, retaining walls, together with some details of buildings for industrial purposes, constructed of steel, or of reinforced concrete. Baker's *Masonry Construction* and *Foundations for Bridges and Buildings* are used as text-books.

90. Mechanism and Valve Gears

Preparation: 11, 40, 42

This course includes a systematic study of the motions and forms of the various mechanisms occurring in machines, and the manner of supporting and guiding the parts.

The latter part of this work is devoted to a discussion of the fundamental systems of gearing, together with their applications and limitations.

The theory and practice of designing valve gears for steam engines, including the plain slide valve, link motions, radial valve gears, double valves and drop cut-off valves are also studied.

91. Mechanical Engineering Drawing

Preparation: 40, 90

In this course the student makes drawings showing the application of simple machine details, such as bolts and nuts, screws, springs, keys, flanges, pipe fittings, etc.; systems of dimensioning, conventional representations, and blue printing are also taught. The larger part of the work consists of drawing, illustrating the class-room work in connection with the courses in Mechanism and Valve Gears, including the design of cams, gear teeth, slide valves, double valves, etc.

92. Machine Drawing

Preparation: 91

The aim of the course is to teach the proper way of making the necessary dimensioned drawings for use in practice, good shop systems being adopted. The instruction includes the

making of working detail and assembly drawings of machinery from measurements.

93. Machine Design, Statics and Dynamics

Preparation: 91, 31

The main object of the course is the application of principles already learned to the solution of problems in design. For each design the constructive details are carefully discussed; each student then makes all the necessary calculations to determine the dimensions of every part, and finally he completes the working drawings. The scope of the designs is such as to include most of the elementary principles of design, and yet is sufficiently limited to enable the student to complete every detail, as it is believed that only by such thorough work can real benefit be obtained.

The work in Dynamics includes a number of the principal applications of Dynamics to moving machinery, such as governors, fly-wheels, the action of the reciprocating parts of the steam engine, running balance, whirling speed of shafts, etc. The work is supplemented by a course in drafting.

Problems of both static and dynamic nature are given, illustrative of the principles studied.

Many problems, illustrating the methods of determining the stresses in machine parts, are given in connection with the course.

95. Heat Engineering: Thermodynamics and Boilers

Preparation: 10, 11, 31

The course includes a study of the principles of thermodynamics; a discussion of the properties of gases, saturated and superheated vapors, especially of air and steam; of the flow of fluids through orifices, nozzles, pipes and meters, a discussion of the action of the steam injector; a study of the various cycles of the hot air, internal combustion and steam engines, of the turbine, air compressor and refrigerator systems. These engineering applications are treated from the physical, analytical and graphical points of view, so as to give the student a good foundation in the principles of thermodynamics, in the solution of actual heat engineering problems. The course also includes a study of the simple, compound and multiple expansion steam engine, of

the different types of gas engines, of the gas producer, of compressed air and refrigerator machines, and the methods of testing such machines.

The various types of steam boilers, with their advantages and applications as regards construction, installation and operation, form the latter part of the course. Steam turbines are also discussed.

96. Power Plant Design

Preparation: 31, 93, 95

The course consists largely of drawing-room work and calculations, with such lectures as may be needed from time to time. The work of the course consists in making the working drawings necessary to show the location of boilers, engines, auxiliaries, piping, coal pockets, etc., for a power house, and also drawings and calculations of some of the details.

97. Engineering Laboratory

Preparation: 95

This course consists of exercises and tests upon the various forms of appliances in use in the power plant, such as:—

Setting Plain Slide Valves, Riding Cut-off Valves, Corliss Valves, etc.

Analysis of Flue Gases.

Calibration of Pressure and Vacuum Gauges.

Calibration of Orifices and Nozzles.

Flow of water over weirs and through a Venturi Meter.

In addition to the foregoing, exercises are given on the Steam Calorimeter, Flow of Steam, Air Fans and Blowers, Flow of Air, Smoke Observations, Steam Boiler Testing, and Steam Engine Indicator Practice.

99. Foundry Practice

A lecture course, in which is studied the general principles and practice of pattern making, and taking up a consideration of sands, tools, molds, cores, ramming, venting, facing, spruing, risers, gateing, use of chills and simpler types of sweep molding.

100. Boiler Design

Preparation: 95

This course is devoted to a consideration of the most modern methods of boiler designing and construction. In connection

with the lectures, the student is required to make calculations and drawings necessary in the design of some approved type of boiler.

101. Forging, Chipping and Filing

This course consists of one two-hour exercise per week, or its equivalent. In the forging work the student is instructed in the building and care of fires, heating, drawing, bending, upsetting and welding.

The exercises in Chipping and Filing give instruction about the various tools and files used, and then the student is given practice in their use by various problems in chipping chamfers, keyways, etc. ; and then in filing problems, as parallel surfaces, filing to template, slide and drive fits, etc.

102. Woodworking and Pattern Work

This is a course designed to give students facility in the common operations of carpentering and cabinet work, together with the use and care of woodworking machinery, as lathes, saws, planers, etc. The course includes instruction in Woodturning, having special application to Pattern-work, an illustrated discussion of the principles of moulding, to explain clearly and show reasons for " Draft " on patterns and methods of allowing it, instruction in the use and making of core-boxes, and methods of building up patterns.

103. Machine Work

This course is to train students in the common operations of metal working, as chipping and filing, forging and machine work, as that done on lathes, drill presses, shapers and milling machines.

104. Factory Construction and Management

This course embraces a study of the types of buildings used for manufacturing purposes, and the principles of construction, covering brick and stone work, floors, columns, and roofs. The use of concrete, the principles of slow-burning construction, the methods of fire protection, and the elementary principles of shop sanitation, are considered in this course. It also includes a study of the organization and relations of the various depart-

ments of an industrial establishment, process mapping, or routing, scheduling of work, the office and engineering departments, methods of superintendence, and a brief discussion of cost accounting. Several lectures and drawing-room exercises are devoted to a study of manufacturing methods in multiple production processes as applied to such industries as gun making and automobile manufacture, with the design of simple drilling, milling and broaching fixtures.

105. Journals and Reports

This course consists of three hours a week of outside reading in standard engineering publications, with one hour per week for class discussion. The course is designed to acquaint the student with general engineering literature and to enable him to read intelligently discussions upon Mechanical Engineering Practice.

110. Hydraulics

Preparation: 31

A course of three exercises per week, during the third year, taken by all students. Both Hydrostatics and Hydrodynamics are discussed and numerous practical problems are solved throughout the work.

Under Hydrostatics, the pressures on submerged areas, together with the points of application are studied; while under Hydrodynamics, the flow of water through orifices, short tubes, nozzles, over weirs, and through pipes and open channels are taken up for discussion.

111. Hydraulic Motors

Preparation: 110

A series of exercises, mainly recitations, based upon a textbook, so as to embrace the laws of flow in open channels, and of the dynamic pressure and work of water flowing over curved surfaces. The time is principally given, however, to a study of impulse wheels and reaction turbines, with reference to their proper construction, regulation and testing, and to the various sources of loss of energy in their operation.

112. Hydraulic and Sanitary Engineering

Preparation: 110

This course treats of the drainage of lands, together with a course in irrigation, in which are studied the constructions and

methods employed in this and other countries, including the arrangement and proportioning of canals and distributaries, and modes of applying water to the soil. A study is also made of the location and capacities of reservoirs and the location and construction of earth and loose rock dams. The student is instructed in the use of hydraulic diagrams for the discharge of conduits and canals, and the flow of water in open channels. Instruction is also given in the theory and practice of stream measurements and the various methods and instruments used in stream gauging. The text-books used are Wilson's *Irrigation Engineering*, Swan and Horton's *Hydraulic Diagrams*, and Hoyt and Grover's *River Discharge*.

120. Electrical Transmission of Power

Preparation : 128, 139

This course is devoted to a thorough study of the design and construction of modern high tension transmission lines. It is in two sub-divisions, the first dealing with the electrical characteristics of the line, such as potentials used, size and spacing of conductors, inductive and capacity reactance, skin effect, coronal loss, effect of harmonics, conditions of resonance, effect of high tension lines on neighboring circuits, etc.; the second covering the parallel problems of rights of way, location of poles, towers and conduits, insulation and insulating devices, protective devices against lightning, flash overs, etc., and, in brief, a discussion of the problem of material realization of the line, as previously planned and calculated.

121. Central Stations

Preparation : 95, 111, 128, 129, 139

This course is given to a consideration of the central station for the production of electrical power, both steam and hydraulic types being considered. Very little time is given to the discussion of the machinery involved, such matters being fully covered in the required preparatory courses. Particular attention is given, however, to the problems of control, protection of apparatus, switching, etc. The course is in the form of lectures, with free use of published descriptions of existing plants, collateral reading, etc. Attention is also given to the problems of development of a water power, location of steam plants, the central station as a power producer, selling at wholesale to other utilities. The

course closes with a brief discussion of the relations between the utility company and the community served.

121A. Electrical Engineering Excursions

This course, which is given in connection with courses No. 120 and No. 121, consists of inspection trips to electric plants and factories in the vicinity of Boston. The purpose is to familarize the student with the various applications of electricity to the commercial field.

122A. Electrical Engineering I., Laboratory and Reports
Preparation : 126

This course of exercises, given throughout the second year, is devoted to a carefully selected series of experiments, intended to exemplify qualitatively, and in the simplest manner, the principles developed in the courses on Direct Current Machines and Direct Current Practice. The purpose of this course being, in part, to develop correct methods of work, it is intended that practically the whole of the preparatory work and working up of results shall be done in the laboratory, under guidance of the instructor, so far as necessary.

122B. Electrical Engineering II., Laboratory and Reports
Preparation : 122A

This course is given over to the study of the characteristics of direct current machines, involving an investigation of such matters as Characteristic Curves of different types of generators, Speed and Torque Curves of Motors, Heat Runs, etc. Then follows a series of experiments involving the testing of machines for Efficiency, and as the course progresses the student is thrown more and more upon his own resources; a desired result is stated to him, and he is required to plan out his own method, settle upon the apparatus needed, solve his precision requirements, calibrate his instruments, if necessary, and finally turn in a detailed report covering all phases of his work.

123. Studies in Electrical Construction
Preparation : 120, 121

This course, which is given in connection with No. 120 and No. 121, consists of visits to plants, manufactories, etc., so far as possible, and written papers by the students upon the various questions involved, together with the reading of the same and their discussion by the class.

124. Elementary Electrical Laboratory

Preparation: 20, 21, 126

This course includes a series of experiments intended to illustrate the fundamental principles of electrical measurement, and to familiarize the student with the handling of the ammeter, voltmeter, etc., preparatory to the work of the more advanced courses. It is required as preparation for all courses in the Electrical Laboratory except 122A.

125. Electrical Problems

Preparation: 126

This is purely a recitation course, based on Lyon's *Problems in Electrical Engineering* as a text-book, and covers the matter contained in the first eight chapters (omitting the seventh), namely, Resistance, Ohm's Law, Kirchoff's Laws, Energy and Power, Direct Current Generators and Motors, and the Electromagnetic Field. It is really designed for the working out of actual engineering problems, illustrating and developing the matters discussed in the parallel courses of Direct Current Machinery and Direct Current Practice.

126. Elements of Electricity

Preparation: 10, 14, 20

This course of thirty-six exercises is taken by all students in the second year, except those in the Electrical Engineering Course, who take it in the first year. It consists of a thorough discussion of the fundamental principles of electricity, and is supplemented by a very considerable amount of problem work upon which the utmost importance is placed. The last nine exercises are given to a discussion of the Rules of the National Electrical Code as they apply to the utilization of electricity in the home, office and shop.

127. Theoretical Electricity

Preparation: 126, 130, 131, 138

This course, given in the fourth year, involves a careful study of the conduction of electricity through solid, liquid and gaseous conductors, and a discussion of power transformation, together with a study of modern electrical theory, so far as is required for an intelligent reading of current publications, such as the *General Electric Review*, *Proceedings of the Institute of Electrical Engineers*, etc.

128. Direct Current Machinery

Preparation: 126, 127

This course, which runs parallel with No. 127, returns to the starting point of the inducing of an Electromotive force by motion of a conductor in a magnetic field, and discusses in detail the theory of direct current generators and motors, armature winding, characteristic curves, etc. The text-book is Franklin and Esty's *Direct Currents.*

129. Direct Current Practice

Preparation: 128

In this course, which follows immediately after No. 128, requiring it as preparation, is given some detailed study of the operation of direct current apparatus, the Edison 3-wire system of distribution, storage batteries, and the more important industrial applications of direct current power.

130A. Technical Electrical Measurements, Lectures

Preparation: 13, 126 and 122A

This course, given during the last six weeks of the second year, and continuing through the first term of the third year, consists of two parts; the first being intended to familiarize the student with the principle types of measuring instruments, used in both commercial work and the standardizing laboratory of the Supply Company, the manner of their use, sources of error, etc.; the second, giving the principles of the fundamental methods of measuring the several electrical quantities—Resistance, Current, Electromotive Force, Capacity, Inductance, Power and Energy.

130B. Technical Electrical Measurements, Laboratory and Reports

Preparation: 130A

This course, given during the third year, and running parallel with 130A, consists of a series of experiments intended to bring out the principles therein developed, and involving such matters as the determination of Specific Resistance, Insulation Resistance, Conductivity, Magnetic Induction, Electrostatic Capacity, and the use of special apparatus, such as the Kelvin Bridge, Cary-Foster Bridge, Potentiometer in the calibration of voltmeters and ammeters, etc.

All through, particular stress is laid on the correct use of apparatus and methods, and precision discussions are required throughout.

131. Variable Currents

Preparation: 10, 11, 12 (taken concurrently), 125

This course, which is preparatory to the more advanced study of alternating currents, is devoted to a thorough consideration of the general differential equations for current in an electrical circuit of variable resistance, reactance and capacity, developed from the general energy equation, and introduced by a consideration of the discharge of condensers through inductive circuits. Some study is also given to the discussion of waves set up in oscillating circuits and the fundamental principles in wireless transmission of energy.

132. Illumination and Photometry

Preparation: 20

A course of lectures dealing with the application of electricity to lighting, the principles of illumination and the laboratory measurement of the various quantities concerned. The text-book used is Wickenden's *Illumination and Photometry.*

133. Electric Railways

Preparation: 128, 129, 139

A course of lectures, including a discussion of the general problem of supplanting steam with electric traction, followed by a discussion of the principal systems of electric traction; namely, Direct Current, high and low voltage, Single Phase Alternating Current systems and Three Phase Alternating Current systems, and a study of the construction, equipment and cost of operation of existing systems.

134. Practical Electricity

Preparation: 20, 21, 126

This course is a continuation of Elements of Electricity, and is given to all students in the Civil, Mechanical and Chemical Engineering Courses during the third year. The first term will be devoted to a consideration of the various direct current machines, their characteristics and applications. The second term work will cover alternating current apparatus in the same manner. Recitations and problem work will be based largely on practical applications.

135. Practical Electricity Laboratory

Preparation: 134, 126

This course parallels, in the laboratory, the work given in the above course. The laboratory work is at all times closely related to the class-room work, and the methods of testing and operating the various machines are carefully discussed in the recitations. A written report on each experiment is required, as the ability to draw accurate conclusions from laboratory work is one of the important objects of any laboratory course.

136. General Problems in Electrical Engineering

Preparation: 126

A course devoted entirely to the solution of problems. From fifty to one hundred carefully selected problems will be assigned. The course has two objects in view: first, to give a thorough review of the principles of electricity covered earlier in the course; and, second, to require the student to correlate and apply these principles in the solution of practical problems.

137. Journals

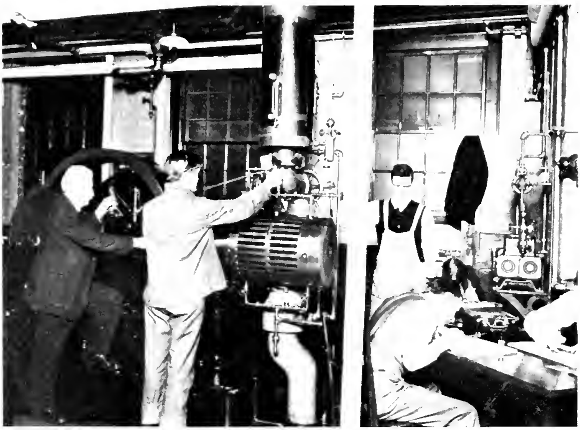
This course consists of written papers, two by each student, in the course of the year, upon some of the various matters observed in "Excursions," together with the reading of the same before, and their discussion by, the class.

137A. Technical Papers and Magazines

The purpose of this course is to give the student practice in using the Electrical Magazines and Proceedings of the Engineering Societies. The work consists of two types: in the first the student may be required to summarize from published papers, throughout a certain period, the work that has been done upon a given subject; in the second, to summarize the important matter found in a number of magazines during, say, a given month, upon various subjects; or again, he may be asked to look up a certain matter in the Patent Office Reports and report upon it.

Each report made by the student is read before the class and open for criticism by the members.

CLASS IN THE ELECTRICAL LABORATORY



ENGINEERING LABORATORY
Taking Indicator Diagrams

138. Alternating Currents

Preparation: 128, 129

This course concerns itself with the general theory of alternating current circuits and the application of these principles to various engineering problems. In connection with the work, considerable importance is attached to the solution of problems selected with reference to their engineering application, two hours per week being devoted to this work.

139. Alternating Current Machinery

Preparation: 138

This course of lectures, recitations and problems is devoted to a careful discussion of the various types of alternating current machinery for the generation, transmission and distribution of power. The special properties of each machine are considered for the machine as a unit, and when it is used as a part of any electrical system; some of the general considerations concerning long distance power transmission are also included. One two-hour period per week is devoted to the solution of various problems pertaining to the work.

139A. Alternating Current Machinery Laboratory

Preparation: 138, 139

The work includes such tests as efficiency, heating, regulation and determination of characteristics for alternating current machinery. The work in the laboratory is supplemented by conferences.

142. Inorganic Chemistry

Preparation: 10, 20

The fundamental principles of the science are taught in connection with the descriptive chemistry of the non-metallic elements. The lectures are designed to precede the work of the laboratory, in which the students are expected to verify and illustrate the principles and facts which have been discussed in the lecture room. Careful manipulation, thoroughness in observation, accuracy in arriving at conclusions, and neatness in note taking, are required of each student. The course lays the necessary foundation for subsequent chemical study.

143. Qualitative Analysis

Preparation : 142

A practical course in qualitative analysis for the separation and identification of the common metallic elements and the acids. Each student is also required to make a complete and accurate analysis of various mixtures, alloys and chemicals used in manufacturing. The laboratory work is supplemented by a course of lectures and conferences, devoted to a general study of the properties of the common metals and their compounds.

144. Quantitative Analysis

Preparation : 142, 143

A course in gravimetric and volumetric analysis. Special attention is given to accurate manipulation, the preparation of standard solutions, the calibration of instruments, and to the principles of stochiometry. In the latter part of the course some time is given to electro-analysis and to rapid methods for iron and steel The laboratory work is supplemented by a course of lectures and conferences.

145. Organic Chemistry

Preparation : 144

A course of lectures on the principles of organic chemistry, as illustrated by the methane and benzene derivatives.

145A. Organic Chemical Laboratory

Preparation : 145

The course aims to familiarize the student with the common apparatus and general procedure used in organic work. To this end he carries out such operations as fractional distillation, extraction, crystallization, and determinations of boiling and melting points. The compounds prepared are such as to give instruction in general methods of preparation, as oxidation, reduction, saponification, nitration and sulfonation.

The student also makes a study of the general principles of organic analysis, and carries out the quantitative determination of carbon, hydrogen, nitrogen and a halogen in organic compounds.

146. Industrial Chemistry

Preparation : 143, 144, 145

This course consists of a series of lectures and recitations upon the more important technical chemical processes, including

those of Metallurgy. Much attention is given to the general operations common to many industries, such as crushing, grinding, lixiviation, filtration, evaporation, distillation, crystallization, etc., and to the details of various types of apparatus used for carrying on these processes. Some of the more important manufacturing industries, such as the production of alkali, fertilizers, glass, pigments, cement, soap, explosives, paper, as well as wood distillation, the refining of petroleum, etc., are also considered in detail.

146A. Industrial Chemical Laboratory

Preparation : 146

A course in the quantitative study of the preparation and purification of some chemical product, selected as a type of reaction of industrial importance. The processes employed are carefully controlled and the final product is analyzed to determine its purity. When the work is completed, a careful detailed report of the whole process is made and discussed in class.

147. General Metallurgy

In this course a study is made of the ferrous and non-ferrous metals most used in engineering work. The production of iron, steel and the more common non-ferrous metals is taken up, and the characteristic properties of each substance are studied, together with its more common uses. Corrosion and its prevention, together with bearing metals, and the more commonly used alloys are given thorough consideration.

148. Technical Analysis

Preparation : 145

A course devoted to the following :—

Analysis of gases.

Analysis of oils, mineral and vegetable.

The origin, manufacture, properties, uses and analysis of the various fuels, and the determination of the heat value of fuels by the use of a calorimetric bomb.

149. Theoretical Chemistry

Preparation : 142, 143, 144

In this course the more important principles of Theoretical Chemistry are considered ; but these are treated with great

thoroughness and are illustrated by applying them to a large variety of problems. The principles are further illustrated by lecture experiments. During the course the following subjects are considered: pressure volume relations of gases and solutions, derivation of molecular and atomic weights, conductivity of solutions, ionic theory and mass action law, effect of temperature on chemical equilibrium, the laws of energy with reference to the production of heat and work, the electro-motive force of voltaic cells and other electro-chemical topics.

149A. Theoretical Chemistry Laboratory

This course comprises a series of exercises to give the student a knowledge of the methods employed in molecular weight determinations, in studying the important properties of solutions. While reasonable accuracy is required, especial emphasis is laid on the underlying principles upon which all work of this character is based.

150. Chemical Engineering

The aim of this course is to train the student to get a clear comprehensive estimate of chemical engineering work, such as he may be called upon to do in the ordinary pursuit of his profession, and to deduce correct and practical inferences from his studies. To this end a carefully planned, systematic study is made of the more important operations as they are carried out in industries of a chemical nature. The various types of equipment, capable of being used for such work, are studied as well as the types which are best suited to certain kinds of work.

151. Factory Inspection and Report Writing

This course consists of visits to chemical plants, and other manufacturing establishments in Boston and vicinity. After each visit, written reports upon the processes studied are submitted to the instructor and discussed in class. In writing these reports the student is expected to supplement the information obtained upon the inspection trip with that obtained from other sources, such as the technical journals and other publications. Especial attention is paid to the use of clear, though concise, English, and to the general appearance of the report.

152. Elementary Photography

This is a brief lecture and laboratory course, intended to familiarize the student with the fundamental principles and operations of photography. The construction and operation of the more common types of plate and film cameras are explained, and a few representative plates, films, and printing papers discussed. The operations of exposing and developing are discussed in some detail, together with the making of positives, both upon paper and upon lantern slides. The laboratory work consists of taking, developing, and printing pictures under the supervision of the instructor. No previous knowledge of chemistry or photography is required. The course is given at the beginning of the second term, and is optional for any student in the School.

160. Dynamical and Structural Geology

This course treats of earth movements and the various terrestrial applications of solar energy. The more important geological processes, erosion, sedimentation, deformation and eruption are taken up and discussed.

The latter part of the course is devoted to lectures on the broader structural features of the earth's crust and the application of the principles of structural geology to practical engineering problems.

170. German I.

This course is planned to give the student a knowledge of German grammar, as well as a working vocabulary of scientific terms. During the course, easy scientific reading is begun.

171. German II.

Preparation: 170

A continuation of German I., in which the student is given full opportunity to extend his vocabulary of technical words, as well as to become familiar with technical books and scientific articles in the current German periodicals.

200. Engineering Practice

This covers the courses in practical engineering work which the student gets with his employing firm. The exact duties performed vary with the different courses, and also vary with the firm. The students are marked for their work bi-monthly and the grades received are regularly noted on the report cards which are sent out every two months.

Equipment

THE School is now housed in the new building of the Association, and has very exceptionally equipped quarters for carrying on the work of the Engineering Courses.

Mechanical Engineering Department

Mechanical Laboratories

Through the courtesy of the Massachusetts Institute of Technology officials, and also those of the Franklin Union, and Wentworth Institute, we are able to avail ourselves of the unexcelled Engineering Laboratories of those Institutions for instruction purposes in the laboratory Courses of the Co-operative School.

In addition to the foregoing facilities, we have several engines of our own for use for instruction, as well as the most modern equipment for gas and fuel analysis.

Our own steam engineering plant is completely equipped with meters, scales, indicators, and all the necessary accessory equipment for making complete boiler tests, and determining the efficiencies of the various appliances used in generating power, heat, and light for our new building. This places at the disposal of our classes a perfectly equipped, up-to-date, engineering department, and gives them the means of carrying on boiler tests, determining the efficiencies of various fuels and oils, taking indicator diagrams, determining the efficiency of modern reciprocating engines and turbines when direct connected to generators, as well as renders them familiar with all the various auxiliary appliances of such a plant, as condensers, pumps, air compressors, etc. The students also have the use of the equipment of our Automobile School, thus giving opportunity to study the most advanced ideas in gasoline engine practice.

Mechanic Arts Laboratories

There are at present two laboratories, one for metal work and the other for woodworking and pattern work, which are available for the use of our students.

The metal working laboratory is well equipped, and affords the student an opportunity for work with various machines, as lathes, shapers, drill presses and milling machines. There are also a gas forge and brazing furnace, together with all the required equipment for bench work instruction.

The woodworking laboratory has a power band saw, lathes, circular saw, buzz planer, and all the necessary equipment for woodworking and pattern work.

In addition to the foregoing, a small, but completely equipped, shop for the construction and repair of apparatus, and for the use of students in connection with their thesis work, has been installed. This shop is equipped with a metal and woodworking lathe, grinder and all the necessary wood and metal working tools. There is also a very complete set of cabinet worker's tools for use in woodworking.

Civil Engineering Department

Field Instruments

For work in the field the Department possesses various surveying instruments, representing the principal makes and types of instruments in general use. The equipment includes transits, levels, compasses, a complete plane table outfit, Locke hand level, flag poles, leveling rods, stadia rod, engineers' and surveyors' chains, steel and cloth tapes and other accessories. For Higher Surveying, an Aneroid Barometer is used for barometric leveling, and the transits are equipped with neutral glasses and reflectors for astronomical observations, as well as a sextant, reading to ten seconds, and equipped with neutral glasses and telescopes. This year a Buff and Buff Plane Table Outfit and a Berger, 18-inch Wye Level, as well as several smaller instruments, have been added to the equipment.

The scope of the equipment and the field work itself are designed to train the student's judgment as to the relative merits of the various types of field instruments.

Design and Drafting Rooms

The School possesses large, light and well equipped drawing rooms for the carrying on of the designing and drafting, which form so important a part of civil engineering work. These

rooms are supplied with lockers containing the drawing supplies, and files containing blue prints and photographs of structures that represent the best practice. Many of the prints and photographs are of structures erected in and about Boston.

Electrical Engineering Department

The Electrical Laboratory is well equipped with apparatus for teaching the principles of measurements, and the equipment is being steadily increased and developed for the doing of work of a higher degree of precision. Among the special pieces of apparatus may be mentioned the following: Cary Foster Bridge, a modified form of Hoopes Conductivity Bridge, a Laboratory Wheatstone Bridge, a Leeds Northrup Potentiometer with Volt box, standard cells and low resistance standards, an accurate Chemical Balance and other appliances for the close determination of currents, resistances and potential differences.

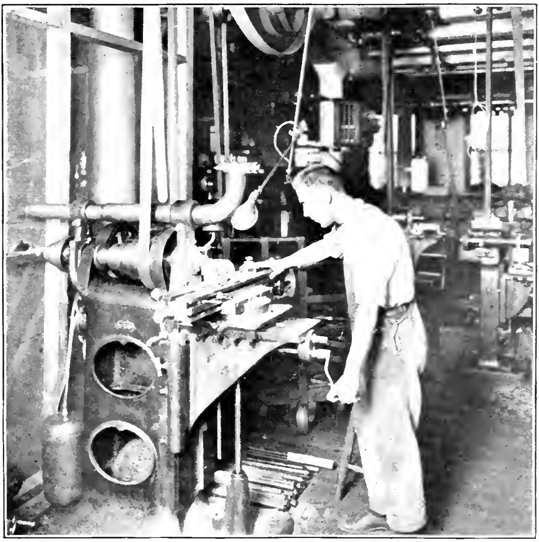
There are also a set of variable inductances, and a set of condensers to the amount of eighty microfarads capacity variable in steps of one-tenth microfarad each.

Among the instruments for testing purposes, for alternating current work, may be mentioned the following: Three matched voltmeters and three General Electric Type P-3 Iron clad wattmeters arranged for Y connection, one G. E. Polyphase Wattmeter with double current and potential ranges, numerous other voltmeters of various ranges, potential transformers, numerous ammeters some with current transformers, three integrating meters, one General Electric and one Westinghouse polyphase, switchboard type, integrating wattmeters and a High Torque General Electric test meter. There is also a considerable and increasing assortment of auxiliary testing apparatus, such as synchronism indicators, power factor indicators, frequency indicators, etc.

For direct current testing there is a large and increasing collection of Weston instruments, both voltmeters and ammeters, of suitable ranges and grades of precision, and two Thomson integrating watt-hour meters, while the measurement of unusual currents and voltages is ensured by four Weston millivoltmeters, with an assortment of standard shunts and multiplying resistances of various orders of magnitude.

CHECKING VOLTMETERS

Head Place Station Edison Electric Illuminating Company



MILLING INSULATOR ENDS

Machine Shop Boston Elevated Railway Company

For calibrating purposes a 600 ampere-hour storage battery has been added to the equipment for current tests, while for voltage work there is a 260-volt potential battery.

There is also the usual assortment of testing devices, such as speed indicators, tachometers, brakes, loading resistances and the numerous minor pieces of apparatus needed in practical testing and operating of electrical machinery.

Among the machines of this Department are a pair of specially made, matched machines arranged to run as single phase, two or three phase generators, or motors, as well as synchronous converters, double current generators, or on the Direct Current side as shunt, series, or compound generators, either two or three wire, or as motors.

There are also a 15 horse power 230-volt Westinghouse motor, a new General Electric 10 horse power Interpole 230-volt motor, a 500-volt generator, two 500-volt series, and several 500-volt shunt motors, and a series parallel controller.

A 45 K. V. A., 60-cycle, single phase, 500-volt generator giving a practically pure sine wave, three General Electric Type H transformers, each of 3 K. V. A. capacity, a 7½ K. V. A., special General Electric 60-cycle 230-volt alternator, with revolving field tapped for either 1, 2, 3 (star or mesh connection) 6 or 12 phase connection, which may be operated also as a synchronous motor.

In addition to the above are a 5 H. P. G. E. single phase induction motor, which may also be operated as a three phase motor and a 10 H. P. Fort Wayne shunt motor driving a special Holtzer-Cabot 3 phase 5 K. V. A. Alternating Current Generator. This latter machine has two special rotors, permitting its use as a squirrel cage or phase wound induction motor, there being a three phase regulating resistance for use with the phase wound rotor.

During the past year there has been added a 5 K. W. Holtzer-Cabot three phase synchronous converter. This is wound for 220 volts on the D. C. side and will permit of the use of the above mentioned specially matched generators as balancers in connection with this unit.

There is also available for advanced instruction, in cooperation with the Mechanical Department, the four three-wire

generators (two driven by reciprocating engines and two by Westinghouse-Parsons turbines) in the main generating plant of the Association.

Department of Physics

There is a large laboratory devoted entirely to Physics together with a lecture room.

The Physics Department has been very completely equipped with all necessary apparatus for the experimental work that is required of the students, as well as that required for lecture demonstration. Among other things have been added: verniers, levels, spherometers, calorimeters, thermometers, pyrometers, a spectroscope, a microscope, a spectrometer, balances, standard gram weight, lecture table galvanometer, optical disk with all accessories, lenses, photometer, a full set of Weather Bureau apparatus, including a barograph, thermograph, hygrometer, barometer, maximum and minimum thermometers, etc. These, in addition to the equipment already owned, give a wide range to the experimental work that can be done.

Department of Chemistry

This Department is completely equipped in all respects for carrying on all lines of Chemical work, from that of a High School to that of most advanced College grade. The three laboratories, with accommodations for over one hundred and fifty students, are very exceptionally furnished with all the necessary appliances for chemical work. Some of these are: hoods, drying closets, still, steam and hot water baths, electrolytic circuits, vacuum and pressure apparatus, balances, combustion furnaces, complete sets of apparatus for the sampling and analysis of flue gases and fuels. There are also testing machines for oils, viscosimeters, and different sorts of flash point apparatus. A chemical museum is connected with this Department where are kept specimens for purposes of illustration.

Libraries

There is in connection with the School a professional library containing books pertaining to both the school work of the boys and to their practical work. In addition to this there also

are current periodicals on engineering and scientific subjects for their exclusive use. All members of the School are entitled to take books from the Boston Public Library, and this offers a very unusual opportunity to our non-resident students.

Department of Physical Training

Our new gymnasium with all the latest modern equipment gives ample accommodation for all students.

There is a running track on the grounds adjoining, together with tennis and hand ball courts; also a large natatorium where swimming is taught by competent instructors.

In connection with this Department there are also six excellent bowling alleys, which may be used by the students upon the payment of a nominal fee.

For all further information, write

THE CO-OPERATIVE ENGINEERING SCHOOL,
316 Huntington Ave., Boston, Mass.

The Co-operative Engineering School

Boston Young Men's Christian Association

Boston, Mass..................................19

To the Dean:

I,..., *hereby respectfully apply for admission to the*..........................*Engineering Course of the Co-Operative Engineering School for the school year* 19 – 19 , *and submit the following statement:*

Name in full...*Age*..................

Residence................................*St*..........................*City, or Town*

State..*Tel*............................

Parent's (father's) name..

" " *address*...

Graduate of............................*High School. Year*....................

If not a graduate, how many years were you in High School? ....

When did you leave?..

Why did you leave?...

Name of principal...

If employed since graduation, what is name of employer? ....

....

Employer's address...

Names and addresses of two other persons, not ministers, to whom we may direct inquiries concerning you. (Give former employers, if possible.)...

....

....

....

Do you plan to complete the full four years' course?......................

Do you wish employment with a co-operating firm?......................

When do you wish to start practical work?......................................

Where will you live during the school-year?..................................

Weight..*Height*..............................

Have you any physical infirmities?...

Is your general health good, fair, or poor?....................................

....

....

....

Remarks

GENERAL DEPARTMENTS

Department of Recreation and Health

ALBERT E. GARLAND, M.D., B.P.E., Director

This Department offers the BEST RECREATION that RE-CREATES. Privileges as follows: Three Gymnasiums, Swimming Tank of Filtered Salt Water, Baths of all kinds, Classes to Music, Six Bowling Alleys, Tennis—Indoor and Out, Handball, Squash, Indoor Golf, Athletics—Indoor and Out, Basket-ball and Games, Boxing, Wrestling and Fencing. Best of Instruction. Medical Direction. *Come in any time.*

Department of Religious Work

EDWIN W. PEIRCE, Secretary

In order that young men may secure a well-balanced development and attain the true foundation for successful living, the Association advises each member to so plan his schedule that he may enter into one or more of the following activities:

Character Building Classes
Young Men's Sunday Forum
Gospel Team
Personal Interviews
Training for Christian Service
Lectures and "Talks"
Worker's Library
Twenty-four-hour-a-day Club

Department of Social Work

DAVID M. CLAGHORN, Director

The attention of members is called to the many opportunities in the Association for social service, and the following social features:

A Newly Equipped Game Room
The Association Congress
Popular Social Evenings
El Club Sarmiento (Pan-American Club)
The Land and Water Club
Concerts and Entertainments

Department of Council and Placement

FREDERICK W. ROBINSON, Director

Advice given to young men concerning their vocational future and efforts made to place them in positions best adapted to their varied abilities.

It also acts as a clearing house for young men seeking work and employers desiring to engage reliable help.

Its service is not limited to members, but the latter are given liberal discounts and effort is made to notify them when good positions are open.

Boys' Division

JAMES G. BARNES, S.B., City Boys' Work Secretary

The Boys' Division is made up of boys from Greater Boston whose needs are ministered to by a force of young men who have made a careful study of "boy-ology." The Division comprises boys from twelve to eighteen years of age, whose needs are studied and whose problems we try to solve. Activities are conducted along social, physical, educational, and spiritual lines. The annual membership fee is $2.00; gymnasium and natatorium privileges are open to the boys at special rates.

THE
CO-OPERATIVE
ENGINEERING
SCHOOL

FOUNDED FOR THE INSTRUCTION OF YOUTH IN THE THEORY AND PRACTICE OF ENGINEERING

THE FRANK WOOD PRESS
BOSTON

NORTHEASTERN
January **COLLEGE** 1917

CATALOG

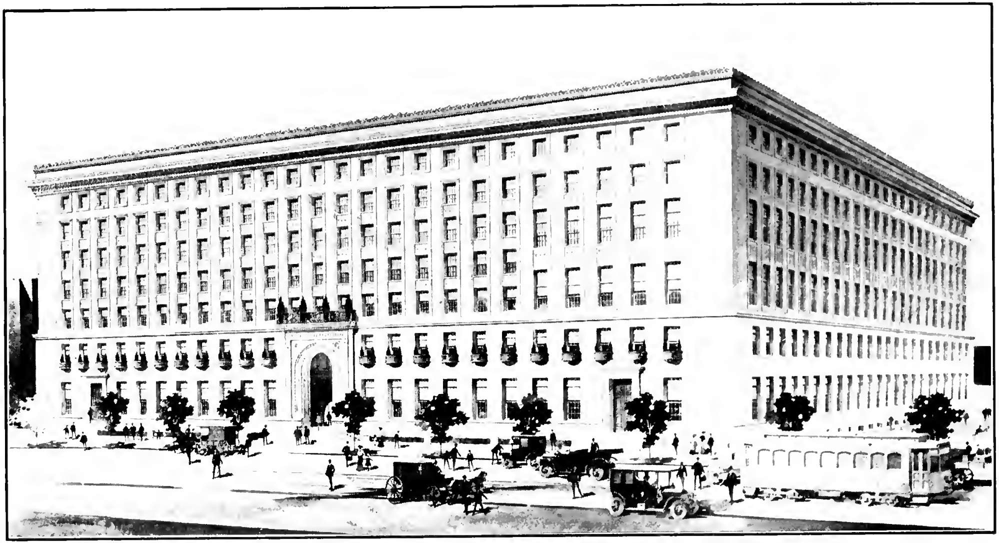
of the

Co-operative
School of Engineering

1917 - 1918

Published by

The TRUSTEES *of* NORTHEASTERN COLLEGE
of the Boston Young Men's Christian Association
Number 316 Huntington Avenue, Boston, Massachusetts



THE ASSOCIATION BUILDING
Home of Northeastern College

CLASS IN SURVEYING FIELD WORK
Making a Stadia Survey of Jamaica Pond

Northeastern College

Announcement

of the

Co-operative School of Engineering

BOSTON

1917-1918

Published by

The TRUSTEES *of* NORTHEASTERN COLLEGE

of the Boston Young Men's Christian Association

Number 316 Huntington Avenue, Boston, Massachusetts

YEARLY CALENDAR

1917

JANUARY

S	M	T	W	T	F	S
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JANUARY

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School Periods for Division A indicated by type thus: 1 2 3.
School Periods for Division B indicated by type thus: **1 2 3**.
Periods when School is not in session indicated by type thus: *1 2 3*.

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Calendar 1917

January 1, Monday
New Year's Day (School exercises omitted)

January 15, Monday
Second Term begins for Division A

January 29, Monday
Second Term begins for Division B

February 22, Thursday
Washington's Birthday (School exercises omitted)

April 19, Thursday
Patriots' Day (School exercises omitted)

May 28 to June 9 inclusive
Final Examinations

May 29, Tuesday
Graduation

May 30, Wednesday
Decoration Day (School exercises omitted)

June 7-8, Thursday and Friday
First Entrance Examinations of Co-operative School of Engineering

June 11-September 8
Summer Vacation

July
Practical work for Division A commences

September
Practical work for Division B commences

September 5-6, Wednesday and Thursday
Second Entrance Examinations of Co-operative School of Engineering.

September 10, Monday
First Term of school year for Division A commences

September 24, Monday
First Term of school year for Division B commences

October 12, Friday
Columbus Day (School exercises omitted)

November 29, Thursday
Thanksgiving Day (School exercises omitted)

December 24-29 inclusive
Christmas Recess (School exercises omitted)

Calendar 1918

January 1, Tuesday
New Year's Day (School exercises omitted)

January 14, Monday
Second Term begins for Division A

January 28, Monday
Second Term begins for Division B

February 22, Friday
Washington's Birthday (School exercises omitted)

April 19, Friday
Patriots' Day (School exercises omitted)

May 27 to June 8 inclusive
Final Examinations

May 28, Tuesday
Graduation

May 30, Thursday
Decoration Day (School exercises omitted)

June 6-7, Thursday and Friday
First Entrance Examinations of Co-operative School of Engineering.

June 10-September 7
Summer Vacation

July
Practical work for Division A commences

September
Practical work for Division B commences

September 4-5, Wednesday and Thursday
Second Entrance Examinations of Co-operative School of Engineering.

September 9, Monday
First Term of school year for Division A commences

September 23, Monday
First Term of school year for Division B commences

October 12, Saturday
Columbus Day (School exercises omitted)

November 28, Thursday
Thanksgiving Day (School exercises omitted)

December 23-28 inclusive
Christmas Recess (School exercises omitted)

Northeastern College

Officers of the College

PRESIDENT
FRANK P. SPEARE, M.H.

SECRETARY-BURSAR
GALEN D. LIGHT, A.B.

Northeastern College

FACULTY

Officers of Administration

FRANK P. SPEARE, M.H., *President*
GALEN D. LIGHT, A.B., *Secretary-Bursar*

The Executive Council

FRANK PALMER SPEARE, M.H.
President of the College

HERCULES W. GEROMANOS, S.B.
Dean of the Co-operative School of Engineering

THOMAS E. PENARD, S.B.
Dean of the Evening Engineering School

MARK A. SMITH, A.M.
Acting Dean of the School of Commerce and Finance

PHILIP F. CLAPP, B.C.S.
Associate Dean
The School of Commerce and Finance

CHARLES NELSON GREGG, A.M.
Acting Dean of the School of Liberal Arts

GALEN DAVID LIGHT, A.B.
Secretary

Co-operative School of Engineering

Advisers

The following gentlemen are acting in an advisory capacity on the more important executive matters of the School, where their service is of greatest value to us:

Dr. Richard Maclaurin, President of Massachusetts Institute of Technology.

Dr. Herman C. Bumpus, President of Tufts College.

James P. Munroe, Secretary of Massachusetts Institute of Technology Corporation.

William McKay, General Manager, New England Gas & Coke Co.

Paul Winsor, Chief Engineer, Boston Elevated Railway Company.

Northeastern College

STAFF OF INSTRUCTION

H. W. GEROMANOS, S.B. (Massachusetts Institute of Technology), Dean.

CARL S. ELL, A.B. (DePauw University), S.B., M.S. (Massachusetts Institute of Technology), Assistant Dean

---

WALTER I. BADGER, Jr., M.A. (Yale), LL.B. (Harvard University), Instructor in English.

JOSEPH A. COOLIDGE, S.B. (Harvard University), Instructor in Physics and Mathematics.

CALVIN P. ELDRED, S.B. (Massachusetts Institute of Technology), Assistant Professor of Electrical Engineering.

CARL S. ELL, S.B., M.S. (Massachusetts Institute of Technology), Professor of Civil Engineering.

H. W. GEROMANOS, S.B. (Massachusetts Institute of Technology), Professor of Chemistry.

ERVIN KENISON, S.B. (Massachusetts Institute of Technology), Instructor in Descriptive Geometry.

FREDERICK R. KNEELAND, S.B. (Massachusetts Institute of Technology), Instructor in Organic Chemistry.

JOHN R. LEIGHTON (Graduate Co-operative School of Engineering), Instructor in Civil Engineering.

HAROLD C. MABBOTT, S.B. (Massachusetts Institute of Technology), Assistant Professor of Mechanical Engineering.

WILLIAM F. ODOM, S.B. (Clemson College), M.S. (Lehigh University), Assistant Professor of Chemical Engineering.

MARCUS F. PINKHAM (Graduate Lowell School for Industrial Foremen), Instructor in Mathematics and Drawing.

W. LINCOLN SMITH, S.B. (Massachusetts Institute of Technology), Assistant Professor of Electrical Engineering.

ELLWOOD B. SPEAR, A.B. (University of Manitoba), Ph.D. (University of Heidelberg), Instructor in Inorganic Chemistry.

HOWARD C. THOMAS, S.B. (Massachusetts Institute of Technology), Instructor in Civil Engineering.

FRANK VOGEL, A.B. (Harvard University), A.M. (Harvard University), Instructor in German.

ROBERT S. WILLIAMS, S.B. (Massachusetts Institute of Technology), Ph.D. (University of Göttingen), Instructor in Qualitative Analysis.

Northeastern College

Staff of Instruction

Continued

ASSISTANTS

ROBERT D. BLACK, Assistant in Chemistry.

IRVING CLAUSING, Assistant in Chemistry.

ROLAND G. PORTER, Assistant in Electrical Engineering.

SPECIAL LECTURERS

PHILIP F. CLAPP, B.C.S., Assistant Dean of School of Commerce and Finance, Northeastern College,
Determination of Factory Costs.

THOMAS E. PENARD, S.B., Station Engineer, Edison Electric Illuminating Co.,
The Mathematics of Engineering.

WILLIAM THOMPSON SEDGWICK, Ph.D., Sc.D., Professor of Biology and Public Health, Massachusetts Institute of Technology,
Public Health.

GEORGE WRIGHT SWETT, S.B., Assistant Professor of Machine Design, Massachusetts Institute of Technology,
Recent Development in Cotton Mill Machinery.

WILLIAM ELGIN WICKENDEN, S.B., Associate Professor of Electrical Engineering, Massachusetts Institute of Technology.
Electrical Engineering as a Profession.
Electrical Transformations of Energy.

THE NEW NAME

Northeastern College

For many years the terms Evening Law School, School of Commerce and Finance, and Co-operative School of Engineering, have been applied to the corresponding schools of the Department of Education. These names, however, were not distinctive, and both graduates and students requested that a regular title be given the schools doing work of college grade. As a result of their activities, the schools concerned were very thoroughly investigated by outside educational experts, to see if the scope and grade of work done would properly measure up to that of the recognized colleges and technical schools. Such was found to be the case in all the schools, and upon the submission of the various reports by the Educational Committee to the Board of Directors of the Association, the latter Board voted to apply the name "Northeastern College" to the group of schools comprising the following:

School of Law
School of Commerce and Finance
Co-operative School of Engineering
Evening School of Engineering
School of Liberal Arts

These schools will henceforth be known as the regular schools of Northeastern College, of the Boston Young Men's Christian Association, and the College has been incorporated under Massachusetts law.

GENERAL INFORMATION

Historical

In September, 1909, the Department of Education of the Boston Young Men's Christian Association started Co-operative Engineering Courses in connection with the Evening Polytechnic School, which it was then operating as one of the schools of its system. At that time, the work was so carried on, that the Co-operative Course students were employed by engineering firms, one working one week, while his alternate was going to school, and at the close of the week exchanging places so that the student who had been to school went to work, while his alternate went to school. At this time, conditions were such that the students attended both day and evening classes. Two years later, by reason of the growth in registration of the new Co-operative Courses, it was decided to start an engineering school, doing work of college grade and based entirely on the part-time, or co-operative idea. Thus, in 1911, was started what is now the Co-operative School of Engineering of Northeastern College.

In the eight years that have elapsed since the inception of the idea, the School, which was started with no special educational requirements for entering students, and which had but little equipment and a registration of only eight pupils, has grown to be a recognized factor in the community, with rigid requirements of scholarship and character for entering students, thousands of dollars' worth of equipment, a highly trained and able faculty, and an enrollment of over one hundred and sixty students. It is enabling the young man of moderate financial ability to get a high-grade engineering training and at the same time not only defray his own expenses, but also become familiar with the actual practice of his profession.

Object of the School

Technical school instruction, depending on class-room work and laboratories, must always lack some of the vital characteristics of an actual manufacturing plant, owing to the fact that one is carried on for educational purposes, while the other

is operated for dividends. It is this latter fact that gives the Co-operative School idea one great advantage over our usual educational plan. Instead of protecting the student, and training him for several years for a line of work to which he may later find himself to be entirely unfitted, the Co-operative School at once puts the boy to work in a commercial plant. There he learns life in its vital issues, as well as the problem of getting along with men; thus early finding out whether he has made a wise, or unwise, choice of his life work. This training, too, shows him the use and value of his school work, and finally gives him an unusual opportunity to acquire from actual experience that rare thing, *executive ability,* without which his life probably will always be spent on the lower levels of industry.

The fundamental aim of this School is to train, for positions in engineering work, young men who are unable to attend the highest grade technical schools, or colleges. Thus they are enabled to advance farther and more rapidly in their chosen work than they could reasonably expect to do without further education than that of a high-school course. The training is not in any sense that of a trade school, nor is it exactly that of our best scientific schools, but it stands between the two. The work done is that of a regular engineering school of high standards, but only the essential subjects are taken, and they only so far as they will have a direct bearing on the life work of the student. In other words, it is a limited technical training of high grade. The fact that most of our instructors are graduates of, or instructors in, the Massachusetts Institute of Technology, will show the character of work being done.

At present there are four lines of engineering work being given, and the end sought is to give to students, who have already had a high-school preparation, or its equivalent, a good training in the fundamental sciences of Mathematics, Chemistry and Physics, and in the important applications of the principles of these sciences to the several branches of engineering. More stress is laid on the development of the ability to apply the acquired knowledge to new engineering problems, than to the memorizing of a multitude of details

and very abstract theory, which, while valuable, cannot be gone into too deeply in a course of this type.

The class-room instruction is given to small sections, and in the drawing rooms and laboratories the students receive a great deal of personal attention. The independent solution of assigned problems forms a large part of nearly all courses.

The courses differ from those of many schools, in that a student is not permitted a wide range of subjects from which to choose, in the belief that better results are obtained by prescribing, after the student has selected the line of work for which he desires to prepare himself, the principal studies which he is to pursue.

Plan of Operation of the School

To illustrate the idea of the curriculum at the School, take, for instance, the case of a young man "A," who desires to take our Mechanical Engineering Course.

"A" is assigned to one of the plants of a firm that is co-operating with us. Here he is put to work, and spends two weeks working for the firm. Then "B," his alternate, who has spent the first two weeks in the School, takes "A's" place with the firm, and "A" puts in the next two weeks at school. Thus the work goes on, the two men exchanging places at the beginning of each two-week period. The studies pursued in the course have a direct practical bearing on the outside work, with the exception of a few courses added, because of the aim which we have to produce a better citizen as well as a better employee. The courses given have been decided upon after conference between the co-operating employers and the school authorities, and are the result of the best ideas of both. The subjects are taught in a practical, not in an abstract or a theoretical way. Thus, in mathematics, instead of teaching algebra, analytic geometry and calculus, as so many separate subjects, they are correlated and taught as instruments for the solution of practical problems arising in engineering work. The aim throughout the course is to give it practical bearing, and yet have it complete and thorough in all the needed essentials.

Relation of the Co-operative School to High Schools

This School is peculiarly adapted to the high-school graduate who, although financially unable to continue his studies further, still has the ambition and ability to get ahead if given the opportunity. Thus boys, being graduated from high school, can still live at home, but spend their time in fitting themselves for something better in the future.

This year the School has a student body made up of graduates of the following high schools:

Amesbury High School
Ayer High School
Beverly High School
Boston College High School
Boston English High School
Boston High School of Commerce
Brockton High School
Bromfield High School
Cambridge High & Latin School
Chelmsford High School
Chelsea High School
Chester High School
Concord High School
Coombs High School (Maine)
Dean Academy
Dennisport High School
East Bridgewater High School
Everett High School
Framingham High School
Groton High School
Hamilton High School
Hanover High School
Haverhill High School
Hebron Academy (Maine)
Holliston High School
Huntington Preparatory School
Littleton High School
Lynn Classical High School
Lynn English High School
Malden High School
Mansfield High School
Marlboro High School
Marblehead High School
Mechanic Arts High School
Medfield High School
Medford High School
Medway High School
Merrimac High School
Natick High School
Newburyport High School
Northbridge High School
North Chelmsford High School
Norwood High School
Peabody High School
Pepperell High School
Plainville High School
Portland High School (Maine)
Petersham High School
Rindge Technical High School
Reading High School
Salem High School
So. Manchester High Sch. (Conn.)
Somerville High School
Stoughton High School
St. John's Preparatory School
Sudbury High School
Tisbury High School
Tilton Seminary
Wallingford High School (Conn.)
Waltham High School
Weston High School
West Roxbury High School
Westboro High School
Winthrop High School

Four-Year Courses

Regular four-year courses, leading to a diploma, are offered in the following branches of engineering:

I. Civil Engineering
II. Mechanical Engineering
III. Electrical Engineering
IV. Chemical Engineering

Descriptions of these courses and schedules, showing the subjects of instruction included, will be found on succeeding pages.

Special Students

It is possible for students to enter the School and spend either every period at school, or else every other period at school, without being placed in practical employment. There will be extra charge under these conditions, if the student takes more than two subjects above the regular schedule for the course and year for which he is entered.

A student obtaining a low rating on his entrance examinations, or who may not be eligible to assignment to practical work, for other reasons, may, by special permission, be allowed to attend school either every period or every alternate period, and, if his record for the year justifies it, may be assigned to practical work the following year.

Requirements for Admission

Detailed information in regard to the requirements for admission to the courses of instruction in the School, will be found on succeeding pages. In general, the preparation necessary to enable an applicant to pursue one of the Courses, corresponds with that given by good high schools in their four years' course.

Expenses

As the earnings of the students average from $150 to $450 a year from their practical work, while expense for tuition, books, drafting supplies, etc., and membership in the Y. M. C. A. is not over $130 to $140, there is a considerable balance for incidentals.

While the School supplies all books, drawing instruments, slide rules, etc., it has been found impracticable to furnish the students with notebooks, paper, drawing ink, pencils, etc. In consequence of this, the student will have a slight expense, of probably less than five dollars, for paper, pencils, etc.

ENGINEERING PRACTICE

Correlation of Practical and Theoretical Work

The outside work of the student is as carefully planned as that at the School, and it is progressive. The employers who co-operate with us generally agree, where practicable, to employ the boys in all the different departments of their establishments during their periods of practical duties; this training is just as complete as the school work, and is just as thorough. Where possible, the course of the learner is from the handling of the raw material to the shipment of the finished product. This practical training includes the use of the machines, as well as the executive duties of the plant, so that at the end of his course the graduate may not only know how to do things, but also why they are done in certain ways; and he may, we hope, be of value in improving methods of work.

Number of Students

The number of positions at our disposal in any one branch of engineering is necessarily limited, and so the number of students who can work part time in that line is also limited. In consequence of this, those students who apply first will get first consideration in the matter of positions, and those who wish to enter should present their applications as soon as possible.

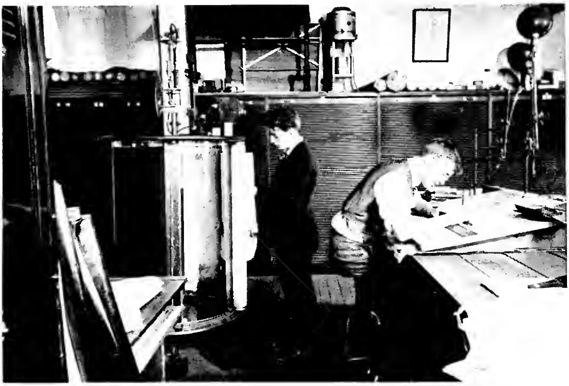
Those applicants who apply for admission to the School too late to be assigned to practical work, may attend the School every period, or every alternate period, as they may wish, and will be assigned to practical work as soon as an opening occurs.

Co-operating Firms

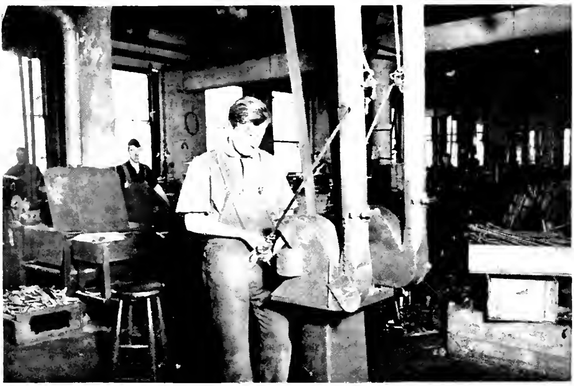
The following is a list of the co-operating firms:

American Steam Gauge & Valve Co.
Thomas A. Appleton, Civil Engineer.
Aspinwall & Lincoln, Civil Engineers.
Bay State Street Railway Co.
H. F. Beal, Civil Engineer.
Bio-Chemical Laboratory.
Boston Elevated Railway Co.
Boston & Albany Railroad Co.
Boston & Maine Railroad Co.
Boston Consolidated Gas Co.
H. F. Bryant, Civil Engineer.
Samuel Cabot, Inc., Manufacturing Chemists.
J. Lewis Carr, Civil Engineer.
Condit Electrical Manufacturing Co.

Students Engaged in Engineering Practice

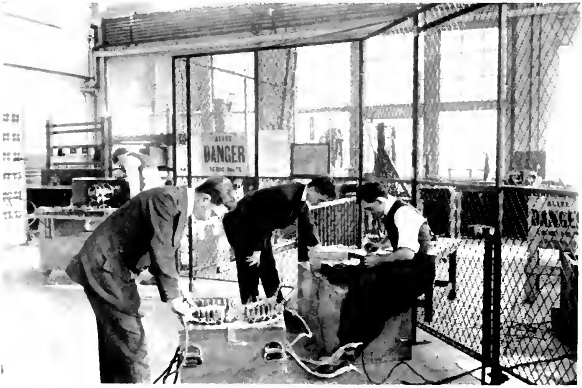


Drafting and Blue-Printing
American Steam Gauge and Valve Company



Grinding Castings
Machine Shop — Boston Elevated Railway Co.

Electrical Engineering Students



Making a High Tension Test
Edison Electric Illuminating Company

Calibrating Relays
Condit Electrical Mfg. Co.

William J. Deed, Naval Architect.
Dennison Manufacturing Co.
Densmore & LeClear, Civil Engineers.
Edison Electric Illuminating Co.
R. Evans, Essex County Engineer.
Hunt-Spiller Co., Iron Founders.
J. H. Long Machine Co.
Lever Brothers Co., Soap Manufacturers.
New England Structural Co.
New York, New Haven & Hartford Railroad Co.
Herbert S. Potter, Electrical Contractor.
Samuel C. Prescott, Sanitary Chemist.
William H. Punchard, Landscape Architect.
Sanborn Co., Instrument Makers.
Fred B. Saunders Co., Engineers.
Fred E. Sherry, Civil Engineer.
Simplex Electric Heating Co.
Simplex Wire & Cable Co.
Tileston & Hollingsworth Paper Co.
United Shoe Machinery Co.
Warren Brothers Co., Paving Materials..
Whidden-Beekman Co., Construction Engineers.
Whitman & Howard, Civil Engineers.

Thus far we have secured new positions for our students as the growth of the School has demanded. However, to be at all sure of work in his chosen branch of engineering, an applicant should file his application early, as the number of positions in any one line is necessarily limited.

Sometimes students may secure their own positions with firms, in which case an alternate can usually be furnished by the School, if desired. Such individual arrangements are entirely acceptable to the School, and may be made by any applicant, subject to the approval of the Dean.

Schedules of Practical Work

Below are typical schedules of practical work that have been prepared for our students by some of the companies which are giving them employment:

Boston Elevated Railway Co.

First Year.	Pit Work in Carhouse,	6 months
	Armature Room,	6 months
Second Year.	Machine Shop Work,	12 months
Third Year.	Mechanical Drafting Room	6 months
	Pattern Shop and Foundry,	6 months
Fourth Year.	Line Department,	6 months
	Electrical Engineer's Department,	6 months

Boston & Maine Railroad Co.

First Year.	Air Brake Shops,	6 months
	Erecting Work,	6 months

Second Year.	Erecting Work,	6 months
	Machine Shop,	6 months
Third Year.	Machine Shop,	6 months
	Mechanical Drafting Room,	6 months
Fourth Year.	Engine House Repairs,	6 months
	Drafting Room and Testing Work,	6 months

Boston Consolidated Gas Co.

First Year.	Data Takers,	9 months
	Office,	3 months
Second Year.	Pipe Fitter's Helpers,	3 months
	Pump Man's Helpers,	3 months
	Blowers and Exhausters,	3 months
	Laboratory,	3 months
Third Year.	Boiler Room,	3 months
	Generator House,	3 months
	Steam Fitters,	3 months
	Machine Shop,	3 months
Fourth Year.	Assistant Engineers,	3 months
	Laboratory,	6 months
	Distribution Department,	3 months

Simplex Wire & Cable Co.

First Year.	Insulating Department,	6 months
	Braiding Department,	6 months
Second Year.	Cable Shop,	6 months
	Twisting Department,	6 months
Third Year.	Machine Shop Construction Gang,	6 months
	Electrical Construction Gang,	6 months
Fourth Year.	Testing Room,	12 months

Simplex Electric Heating Co.

First Year.	Machine Department,	12 months
Second Year.	Grinding Department,	1 month
	Stock Department,	4 months
	Winding Department,	½ month
	Enameling Department,	½ month
	Assembling Department,	6 months
Third Year.	Testing Department, First Division,	6 months
	Testing Department, Second Division,	6 months
Fourth Year.	Shipping Department, approximately,	2 months
	Drafting Department, approximately,	4 months
	General Shop experience,	6 months

Condit Electrical Manufacturing Co.

First Year.	Shipping or Receiving,	4 months
	Cost and Estimating,	4 months
	Stock Room,	4 months
Second Year.	Machine Department,	4 months
	Direct-Current Assembly,	4 months
	Alternating-Current Assembly,	4 months
Third Year.	Inspecting and Testing Department,	6 months
	Experimental Department,	3 months
	Drafting Department,	3 months
Fourth Year.	Switchboard Department,	6 months
	Engineering Department,	6 months

The Dennison Manufacturing Co.

FIRST YEAR.	Carpenter's Helper,	4 months
	Pattern Maker's Helper,	3 months
	Elevator, Fire Door, Shafting, etc.,	2 months
	Helper in Millwright's and Electrician's Gangs,	3 months
SECOND YEAR.	Machine Shop Stock Room,	1 month
	Machine Shop,	9 months
	Grinding Room,	2 months
THIRD YEAR.	Power Plant Work (the time to be put in at the option of the Company),	3 months
	Accident Prevention Work,	4 months
	Experimental Work (machine work),	3 months
	Filing Plans, Blue Printing, Tracing, etc.,	2 months
FOURTH YEAR.	Tracing and general work,	2 months
	Detailing and General Drafting,	10 months

Boston & Albany Railroad Co.

FIRST YEAR.	Work in Field Party,	12 months
SECOND YEAR.	Work in Drafting Room,	12 months
THIRD YEAR.	Masonry Inspection and General Railroad Work,	6 months
	Railroad Accounting,	6 months
FOURTH YEAR.	Railroad Accounting,	6 months
	Timekeeping and Unit Costs,	6 months

The above programmes show what the students do in their practical work, and the courses of study pursued at the School show what they do along academic lines. It will be seen that there is the greatest possible degree of correlation between theory and practice in the work they take up. The men under whose supervision the boys have been in their outside work are practically unanimous in approval of our plan, and speak highly of the enthusiasm, earnestness and intelligence the students have shown in the performance of their duties.

Attitude of Co-operating Firms

The best measure of the attitude of the co-operating concerns toward our plan is found in the retention of the students from year to year, as well as after graduation, and also in the fact that whenever a vacancy occurs which can be filled by our men, immediate application is made for additional students to fill the position.

Earnings

For the practical work the student does he is paid a certain amount per hour at the start, and a definite increase per hour after completing fixed periods of service. The sum earned is

more than enough to pay the tuition and the necessary expenses of schooling, but will not cover the cost of living.

In many cases the boys are paid at a higher rate than is called for by their schedule of pay, but that is a courtesy of the company that gives them employment, and is not in any way to be expected as a regular thing. The co-operating firms may make any salary schedule they desire, so long as it does not fall below that originally agreed upon.

The companies which co-operate with us agree to pay our students not less than ten (10) cents per hour during their first year of service; twelve (12) cents per hour during the second year; fourteen (14) cents per hour during the third year; and sixteen (16) cents per hour during the fourth year.

Basing the earnings on this scale, the student will earn from five (5) to six (6) dollars per working week, during the first year, and an increase of approximately one (1) dollar per working week for each succeeding year of the four. As there are about thirty weeks of work per year, the earnings will be from one hundred and fifty dollars upwards.

Frequently a student is able to earn much more than the regular rate, owing to getting extra pay for overtime work.

A census of our students who were working in January, 1917, gave the following data in regard to earnings:

Minimum weekly wage,	$5.00
Maximum weekly wage,	15.00
Minimum earnings for January, 1917,	10.00
Maximum earnings for January, 1917,	30.00
*Minimum earnings for year 1917,	150.00
*Maximum earnings for year 1917,	450.00

*Based on a total working period of thirty weeks.

REQUIREMENTS FOR ADMISSION

General Statement

In general, the preparation necessary to enable an applicant to pursue successfully one of the regular courses corresponds with that afforded by high schools of the better grade, offering a four-year course of study. Experience has shown that students who have not a complete high school course, or its equivalent, are severely handicapped in their work, so that such previous training is regarded as just as essential for entrance as the satisfactory passing of the required examinations.

In very exceptional cases a student who is not a high school graduate may be allowed to enter as a special student, but only after his case has been passed on favorably by the Faculty and the Dean.

Every applicant must furnish references as to his character and ability, and must show cause why he may reasonably be expected to make a success of his course, both in the practical work and at the School. He must be willing and able to work hard, both mentally and physically.

For those unable to carry on the Engineering Courses owing to inadequate preliminary training, it has been found possible to plan special courses, of one or two years' duration, in the Preparatory School to fit for the Engineering School.

All applicants planning to take the examinations shall notify the Dean not less than ten days previous to the date of the examinations. For those students who may not be prepared to take the examinations in June, but who desire to work during the summer and then take the examinations in the fall, arrangements may be made by consultation with the Dean.

Any subjects not passed in the June examinations may be passed at the September examinations.

Applicants for admission to the Co-operative Engineering School are, in general, required to pass the entrance examinations of the School. Certificates of entrance examinations passed for admission to colleges, or technical schools of good standing, may be accepted in lieu of examinations.

The last page of this catalog is in the form of an applica-

tion blank. It should be filled out in ink and forwarded, with the required five dollar deposit, to H. W. Geromanos, Dean, 316 Huntington Avenue, Boston, Mass. Make all checks and money orders payable to The Bursar, Northeastern College.

Admission to the First Year

The student intending to enter the School should bear in mind that the broader his intellectual training in any direction, and the more extensive his general acquirements, the greater will be the advantages he may expect to gain. The importance of thorough preparation in the subjects set for examination also is great, for the character and the amount of instruction given in the School, from the outset, leave little opportunity for one imperfectly fitted to make up deficiencies, and render it impossible for him to derive the full benefit from his course, or perhaps, even to maintain his standing. The training given in the best high schools will, in general, afford suitable preparation.

The requirements of age and scholarship specified are regarded as a minimum in all ordinary cases, and only exceptional circumstances will justify any relaxation. Parents and guardians are advised that it is generally for the ultimate advantage of the student not to enter under the age of eighteen years.

Application for Admission

Each applicant for admission to the School is required to fill out an application blank, whereon he states his places of previous education, as well as the names of persons to whom reference may be made in regard to his character and previous training.

A deposit of five (5) dollars is required when the application is filed. Should the applicant be rejected, without being permitted to take the entrance examinations, one-half this fee will be returned to him. Should the application be approved, the fee will be retained to cover the cost of his registration, examinations, etc. This fee is non-returnable.

The last page of this catalog is in the form of an application blank, which may be detached and filled out to send in with the $5 matriculation fee.

REQUIREMENTS FOR ADMISSION

Upon receipt of the application blank, properly filled out, together with the required deposit, the School at once looks up the applicant's references and high school records. When replies have been received to the various inquiries instituted, the applicant is at once advised as to his eligibility to admission to the School. All applicants must meet the Dean for a personal interview before being finally accepted by the School.

Preliminary Fee and First Tuition Payment

Should a student wish to be assigned to a position with a co-operating firm before the regular opening of School, he is required to fill out an attendance card and also an application for membership in the Association. A twenty-five (25) dollar fee, which is credited as part payment of tuition, must be paid before he will be assigned to any position at practical work. Once the student has been assigned to such a position, and has accepted it, this fee is non-returnable.

Before any student shall be allowed to attend classes, or be given supplies, he shall have made a total payment of sixty (60) dollars. This is entirely separate from the application fee of five (5) dollars.

Summing up the foregoing:

When a student applies for admission to the School, he makes a deposit of five dollars, which is not considered as part of the tuition, but is used to cover registration expenses. Of the hundred and twenty-five (125) dollar tuition, twenty-five (25) dollars must be paid before an applicant will be assigned a position at practical work, and an additional thirty-five (35) dollars, or in all, sixty dollars, must be paid before a student will have books and supplies issued to him and be allowed to attend classes.

An application blank will be found just inside the back cover of this catalog. Fill it out in ink and mail it, together with the required five (5) dollar deposit, to H. W. Geromanos, Dean, 316 Huntington Avenue, Boston, Mass. Make all checks and money orders payable to the Bursar, Northeastern College.

Birth and Educational Certificates

The passage of the recent law, by the Legislature, in regard to the hours and conditions of labor by minors, makes it necessary that all students under twenty-one years of age shall obtain Educational Certificates before they can be accepted by co-operating firms. For those students who plan to take the practical work, and who live outside of Boston, it will save time and trouble to bring a Certificate of Birth, or an Educational Certificate, with you on coming to Boston. The Educational Certificates are obtained free, upon request, from the Superintendent of Schools in the city, or town, where the student lives, if he lives in Massachusetts. For students living in other states a Certificate of Birth, or its equivalent, is all that will be necessary.

Entrance Examinations in Boston

Examinations for admission to the first year class will be held at 316 Huntington Avenue on June 7 and 8, and on September 5 and 6, 1917.

Students are advised to attend the June examinations, if possible, in order that any deficiencies then existing may be made up in September, before entrance.

Examination Fees

Before taking the examination, the applicant must have filed his application, together with the required five dollar deposit. If he gets a clear record in his examinations, he may pay the sixty (60) dollar first payment of his tuition fee, at any time before school opens. If, however, he wishes to start practical work, he must pay the preliminary fee of twenty-five dollars before being assigned to a position.

Order of Examinations

Thursday, June 7, 1917.	
10.00 a.m. to 12.00 noon,	Algebra
1.00 p.m. to 3.00 p.m.,	Plane Geometry
Friday, June 8, 1917.	
10.00 a.m. to 12.00 noon,	English
1.00 p.m. to 3.00 p.m.,	Physics

No fees are to be paid at this time.

Subjects for Examination

To be admitted as a student to the first-year class, the applicant must have attained the age of seventeen years, and must have passed satisfactory examinations in the following subjects:

Elementary Algebra.

Plane Geometry.

English.

Elementary Physics.

The examination in Physics is not required, but students not receiving a clear record in it, by examination, or otherwise, will be required to take a special course in Physics, in addition to their regular first-year work.

Beginning in June, 1918, the examination in Physics will become a regular requirement for entrance to the School.

The detailed requirements in the various subjects are as follows:

Plane Geometry

The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas, regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

Algebra

The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one, or more, unknown quantities; problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative.

English

The examination in English will be, as far as possible, a test of the candidate's ability to express himself in writing, in a manner at once clear and accurate.

The candidate will be required to write upon subjects familiar to him. His composition should be correct in spelling, punctuation, grammar, idiom and formation of paragraphs, and should be plain and natural in style. He will be judged by how well, rather than by how much, he writes.

Physics

The candidate will be expected to be familiar with the fundamental principles of Physics. It is especially desirable that he should have a good knowledge of general mechanics and of the mechanics of solids, liquids and gases. A knowledge of physical hypotheses is comparatively unimportant. Text-book instruction should be supplemented by lecture-room experiments. A sufficiently extended treatment of the subject will be found in any of the principal text-books now in use in secondary schools. Ability to solve simple problems will be expected.

Students presenting laboratory notebooks in Physics, properly endorsed, will be allowed 10 per cent on the examination rating, for such books as are accepted. That is, an accepted notebook adds 10 per cent to whatever rating is obtained on the written examination until the sum of both credits shall reach 100 per cent.

Admission by Certificates

Students presenting certificates from a preparatory school, which has the certification privilege, in any, or all, subjects required for entrance, may be given credit in those subjects, without an examination, upon application to the Dean. Such applications, together with a certificate from the principal, or instructor, stating the work done and the ranks received, shall be filed with the Dean, not less than ten days preceding the examination date.

The right is reserved to require any applicant to take the Entrance Examinations, without regard to such certification, should it be deemed necessary.

Conditions

A candidate failing in only one or two of the examination subjects, may be admitted with "conditions." A candidate incurring conditions in June must repeat, in September, examinations in those subjects in which he has failed.

In any case of a condition existing after a second examination in a subject, special arrangements must be made with the Dean before a student will be allowed to attend classes.

Probation Period

When, for any reason, it is deemed advisable, the School reserves the right to place any entering student upon a period of probation, extending from one to three months, before placing him at practical work. Whether he shall be placed at work at the end of this time will be determined by the character of the work that he has accomplished during this probationary period.

Modern Languages

There is no requirement in the modern languages for entrance to the School, and students who desire to take up these subjects during their course may do so, provided they show the capacity to handle such work in addition to the required subjects.

Outlines of Subjects Required for Entrance

By writing the School, prospective applicants may receive a brief outline covering the subjects in Physics and Algebra upon which the Entrance Examinations are based. These outlines are issued in order that the applicant may concentrate his study upon subjects that are essential to the work, and not spread his efforts over too large a field.

Where available for distribution, copies of past entrance examinations in the various subjects may also be obtained, by writing the School.

SCHOOL INFORMATION IN DETAIL

Location

The buildings are located on Huntington Avenue, just beyond Massachusetts Avenue, and are within easy access to the various railroad stations, and the business and residential sections, by electric cars.

Residence

It has been found to be much more satisfactory for the student to live within easy access of Boston, than to live out twenty-five or thirty miles. The saving of time and effort more than offset any increased expense, and it is recommended, that, where possible, arrangements be made, to this end, if necessary. Such local residence also enables the student to have a wider range of positions to choose from, as he can readily report for work at 7 a.m., if necessary, which is impossible for those students living at a distance.

Where students live in towns, or cities, twenty-five or thirty miles from Boston, it is often possible to arrange for them to work in, or near, their home towns, during the periods of practical work, by getting some local concern to furnish them with suitable employment.

For those students who will not be living at home, there are excellent accommodations, at very moderate rates, in the dormitories that are in our new building. These rooms may be had separately, or in groups with a common reception room, and the price varies from $1.50, or $2.00 per week, upwards. As board costs from $3.50 to $5.00 a week, a student could get room and board for from $5.00 a week to $6.00 per week.

The School officials have no authority in the matter of dormitory assignments. For rooms in the dormitories, write the House Secretary.

School Year

The term begins September 10, 1917, and on succeeding years the school year will commence on the second Monday in September. The school exercises are suspended on legal holidays and for one week at Christmas. The School closes at the end of the second week in June.

Attendance

Students are expected to attend all exercises in the subjects they are studying, unless excused by the Dean. With the exception of one hour in the middle of the day, exercises are held, and students are, in general, expected to devote themselves to the work of the School between 9 a.m. and 5 p.m. on every week day, except Saturday. Saturday classes are held only between 9 a.m. and 12 noon.

Tuition Fees

A fee of five (5) dollars is to be paid when the application is filed, as a matriculation fee. This fee is non-returnable, if the applicant is permitted to take the entrance examinations. If he is rejected, without taking the examinations, one-half the deposit will be returned.

The tuition fee is $125 per year, and must be paid by entering students as follows:

Twenty-five dollars preliminary fee (see previous page).

Thirty-five dollars additional, before receiving any supplies.

or,

Sixty dollars before attending classes and receiving supplies.

Thirty-five dollars December 1.

Thirty dollars March 1.

One-half the year's tuition will be charged any student who attends the School during six school weeks.

Any student whose application for entrance to the School, together with the required deposit of $5, was received, on or before, December 31, 1915, is entitled to the $110 rate of tuition.

Upper class students whose tuition rate is $110 shall pay it as follows:

Forty dollars at beginning of fall term.

Forty dollars December 1.

Thirty dollars March 1.

Students who were enrolled in the School, when the tuition was increased from $110 to $125 per year, will be

allowed to complete their course at the same rate of tuition that existed at the time of their entrance.

Failure to make the required payments on time renders the student liable to be barred from his classes until the matter has been adjusted with the Bursar.

This tuition fee includes membership in the Association, as well as the use of all books, drawing instruments, etc., which are required in the school work. Such supplies as are required by the student for his school work are loaned to him by the School, and must be returned on demand, in good condition, or else paid for.

Special Tuition Fee for Three-Year Course

Students completing one of the four-year courses in three years will be required to pay the full tuition of the four-year course, namely, five hundred (500) dollars, before being awarded a diploma. The extra tuition shall be added to the regular tuition as follows:

First year—Fifty dollars.
Second year—Fifty dollars.
Third year—Twenty-five dollars.

The foregoing excess payments, over the year's tuition, shall be paid in installments with the regular tuition payments as follows:

First and Second Years.

Twenty-five dollars at the beginning of the fall term.
Twenty-five dollars December first.

Third Year.

Twenty-five dollars at the beginning of the fall term.

The extra tuition payments required for the three-year course do not apply to those students enrolled in the School before January, 1916.

Laboratory Fees and Breakage

All students taking Chemical Laboratory work are charged a nominal fee of five dollars per year. Students are charged for all breakage and destruction of apparatus in all laboratories.

Refunds

Students who are compelled, for any reason, to leave the School before the end of the school year, shall be charged at the rate of seven and one-half dollars per week for each week of school attendance, and in addition to this, shall be charged an extra twenty dollars, over and above this weekly rate. The date of withdrawal of any student shall be the day on which the School receives formal notice of his intentions to leave, at which time also all his supplies shall be returned, or paid for. No application for refunds will be considered until the student's supplies have all been returned, or paid for.

Payments

All payments should be made to Galen D. Light, Bursar.

Make checks payable to The Bursar, Northeastern College.

Books and Supplies

The student is furnished with all books, drawing instruments, slide rules and general supplies required for his work. This material is loaned to him during the school year, and must be returned in good condition, on demand, or else paid for.

Such materials as pens, pencils, note-books, triangles and scales, and drawing paper and tracing cloth, are not supplied by the School, but may be purchased by the student at an expense not to exceed five dollars a year.

Three-year Course

It has been found possible for students to attend school every week and to complete the course in three years. To do this, the student must have had a good high-school education and cannot do the practical work in connection with the course.

Special permission to take a three-year course must be granted by the Faculty before a student will be permitted to enroll for such a course.

Students completing the course in three years will be required to pay the full tuition of the four-year course, namely, five hundred (500) dollars, before being awarded a diploma.

The extra tuition shall be added to the regular tuition as follows:

First year—Fifty dollars.
Second year—Fifty dollars.
Third year—Twenty-five dollars.

The dates upon which the partial payments of these extra amounts shall be made are stated on another page under "Tuition Fees."

Elective Subjects

Students electing any subject, not included in their regular schedule, will be required to take all examinations in the subject, and to attain a passing grade before they will be eligible for the diploma of the School.

Status of Students

The ability of students to continue their courses is determined in part by means of examinations; but regularity of attendance and faithfulness to daily duties are considered equally essential.

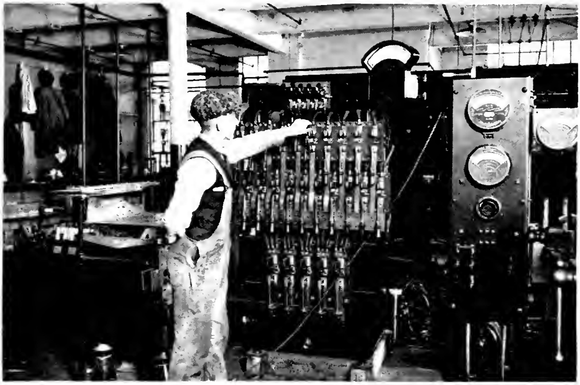
Any student failing to make a satisfactory record, either in school or practical work, may be removed from his position in practical work, or from the School.

Examinations

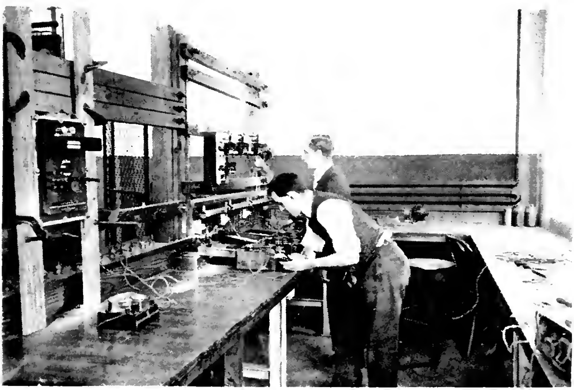
Examinations in all subjects are held at the close of each school year, in May and June, and cover the work done during the year. All students who maintain a year's average of 80 per cent, or over, in their daily work and informal examinations, in any subject, may be excused from the final examination in that subject, at the discretion of the instructor in charge, and with the approval of the Dean. When a final examination is taken, the year's rating in the subject is based half on the examination and half on the record of the year's work.

Students will not be admitted to professional work in the several courses without satisfactory records in those previous subjects on which this work especially depends. That is, for

Electrical Engineering Students

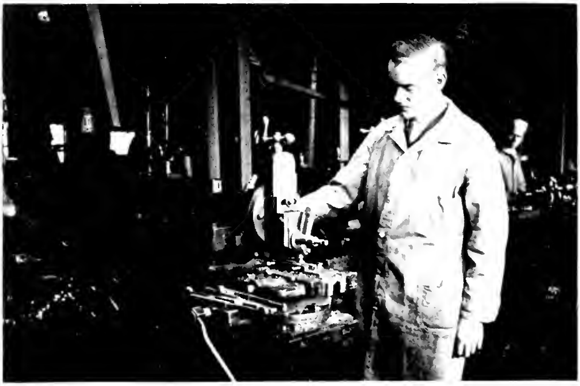


Testing a 10,000 Ampere Storage Battery
Condit Electrical Mfg. Co.



Testing Meters
Edison Electric Illuminating Co.

Mechanical Engineering Students



Operating a Shaper
J. H. Long Machine Company

Class in Applied Electricity
Electrical Engineering Laboratory

illustration, a student cannot take Advanced Surveying, until he has completed Elementary Surveying, with a clear record.

Exceptions to this rule may be made in individual cases, after special consideration by the instructor in charge and the Dean.

Failure to take an examination at the proper time, unless excused, counts as a complete failure, and no other examination may be taken by the student in that subject without special permission and a payment of five dollars for each examination.

Reports of Standing

Informal reports of the students' standing are issued three times during the school year, and formal reports, covering the year's work, are issued at the close of each year. These reports are made in duplicate, one copy being furnished directly to the student, while the other is sent to his parents, or guardian.

Notification will be made to parents, or guardians, in all cases of students advised, or required, to withdraw, or placed on probation.

Owing to the short school year, it is of vital importance to the student that he get a clear record in all his work each week, and where a student fails to pass in any subject, a notification may be sent to his parents, or guardian, to that effect, so that we may have the home influence exerted to bring his work up to a higher rating.

Every effort is made to keep the student up in his studies, and parents and students are always welcomed by the Dean for conference upon such questions. Special reports on a student's work will be sent to parents at any time, upon request.

Conduct

It is assumed that students come to the School for a serious purpose, and that they will cheerfully conform to such regulations as may from time to time be made. In case of injury to any building, or to any of the furniture, apparatus or other property of the School, the damage will be charged to the student, or students, known to be immediately concerned; but

if the persons who caused the damage are unknown, the cost of repairing the same may be assessed equally upon all the students of the School.

Students are expected to behave with decorum, to obey the regulations of the School, and to pay due respect to its officers. Conduct inconsistent with the general good order of the School, or persistent neglect of work, if repeated after admonition, may be followed by dismissal, or, in case the offense be a less serious one, the student may be placed upon probation. The student so placed upon probation may be dismissed if guilty of any further offense.

It is the aim so to administer the discipline of the School as to maintain a high standard of integrity and a scrupulous regard for truth. The attempt of any student to present, as his own, any work which he has not performed, or to pass any examination by improper means, is regarded as a most serious offense, and renders the offender liable to immediate expulsion. The aiding and abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Socials

In order to provide for the social intercourse of the students, as well as to enable the men in the different divisions to meet one another, socials and entertainments are held for their exclusive enjoyment. An out-door field meet is also held yearly, at the close of the school year, at which time various interclass competitive games are enjoyed.

Outside Interests

A moderate participation in social and athletic activities is encouraged by the Faculty, although a standard of scholarship is required of the students which is incompatible with excessive devotion to such pursuits.

Physical Training

By a special arrangement between the Department of Recreation and Health and the School, it has been made possible, for those students who desire it, to get the privileges of the gymnasium and natatorium, for special hours, upon

the payment of five dollars, in addition to the tuition. By this means our students may avail themselves of these privileges at a minimum cost.

Vacations

The employers may allow our students one week's vacation at Christmas, and two weeks' vacation during the summer, with, or without, pay, at their discretion. Whether a student shall have a full week at Christmas, or not, is at the option of the employer.

Summer Employment

When a student, for good reason, is unable to continue his practical work during the summer, while the School is not in session, it is sometimes possible to get him leave of absence for the summer so that he can return to his employer in the fall. All special arrangements for the summer work must be referred to the Dean.

Summer Schools

There are day and evening summer preparatory schools, conducted by the Educational Department of the Association, and students having entrance conditions, or requiring further preparation for the entrance examinations, may avail themselves of this opportunity to cover the desired work.

Those of our students who fail to pass in any of their school work, may be permitted to take up the study in the Summer School conducted by the Institute of Technology, provided, of course, that Institution is offering such a course. Those students desiring this privilege should consult the Dean, as special permission must be obtained to attend many of the courses.

STUDENT ACTIVITIES

Clubs and Teams

The student body has organized into a number of groups, or clubs, and this year we have a Glee Club and Orchestra, in addition to our Basketball and Baseball Teams.

The various activities of the teams are financed by the Athletic Association of the School.

"The Co-op"

For the first time in the history of the School, a monthly paper has been issued by the students, called *The Co-op*. Pertinent articles by prominent men, as well as school information, make this new departure very valuable, and it has met with such unqualified success that it will be retained as a permanent feature.

PROFESSIONAL SOCIETIES

The students in the various courses have organized professional societies for the closer association of the students in any one course, and for the discussion and consideration of various problems and new knowledge in their chosen lines.

Meetings are held every few weeks, at which the members are addressed by engineers and other men of prominence.

There are four of these societies in the School, one for each course, namely:

The Civil Engineering Society.
The Mechanical Engineering Society.
The Electrical Engineering Society.
The Chemical Engineering Society.

All students in the corresponding course of the School are eligible for membership in the Society for that course, upon election to membership and payment of the required fees.

REQUIREMENTS FOR GRADUATION

To receive the diploma of the School the student must have attended the School not less than two years, which must be those immediately preceding his graduation, except as postponement may be specially permitted. He must have completed the prescribed studies of the four years, and must, also, pass final examinations, if required, on subjects pertaining especially to his course. In addition to this, he must have completed his period of practical work to the satisfaction of his employer.

The student must, also, prepare a thesis on some subject included in his course of study, or an account of some research made by him, or an original report upon some machine, work of engineering, or industrial plant. This thesis, or design, must be approved by the Dean. Theses are to be written on one side only of paper of good quality, 8 x 10½ inches in size, with an inch margin on each side. Theses must be handed to the Dean not later than the day on which the first annual examination occurs.

All theses, and records of work done in preparation of theses, are the permanent property of the School.

The diploma of the School represents not only the formal completion of the subjects in the selected course of study, but also the attainment of a satisfactory standard of general efficiency. Any student, who does not show in the fourth-year work of his course that he has attained such a standard, may be required, before receiving the diploma, to take such additional work as shall test his ability to reach that standard.

No diploma can be given until all dues to the School are discharged.

The diplomas awarded graduates will be signed by both the School authorities and the employers.

Students completing the school course, without being engaged in any practical work, will receive a special diploma.

POST-GRADUATE OPPORTUNITIES

While the courses of the School have been carefully investigated by men who are recognized as authorities in their professions, who have pronounced the work to be of the grade

and scope of good scientific schools, no degree is granted upon graduation.

For those who wish a degree, it may be obtained as follows:

By arranging a special schedule for the last two years of the Co-operative School course, and then putting in a full year in our School of Commerce and Finance, a student may get a valuable education in both Engineering and Accounting and qualify for the degree of B. C. S.

Students of good ability, on completing the Co-operative Engineering Course, have the opportunity to attend the Massachusetts Institute of Technology, if they care to, and by taking special extra work in the Co-operative School during their course, they may reasonably expect to complete the Technology work and get their degree in two years. Through conference with the officials of the Institute, it has been found that those of our courses equivalent to theirs will probably be accepted in place of theirs, and the student given a clear record in such subjects, either by passing examinations, or at the discretion of the head of the Department. Since a large number of our courses are covering the same ground as those at the Institute, a capable student should be able, at the end of his course, to get a clear rating at Technology, equivalent to at least two years' work there. This offers a rare opportunity for an ambitious, capable young man to get the most valuable kind of an education at small cost.

POSITIONS HELD BY GRADUATES

The graduates of the School have been able to secure the same type of positions, and the same salaries, as are commanded by the graduates of any of our good technical schools.

Some of them have become engineers in charge of construction, some electrical engineers, some designing draftsmen, some have been employed by the State, or Federal Government, under Civil Service, and still others have gone into teaching. The success of those who have been graduated from the School, is the best evidence as to the value and thoroughness of the training offered.

For further information about the School, write to

H. W. Geromanos, *Dean*,
316 Huntington Avenue, Boston, Mass.

Courses of Study

GENERAL INFORMATION

The schedules of the various courses are given on the following pages. The first-year work of all courses is practically the same, with a few exceptions, which are made because of the need of the student for elementary training in his professional subjects. This is done so that he may gain more from his early practical work, as well as be of more use to his employer by reason of a better understanding of the duties he may be called upon to perform.

The school year comprises eighteen weeks of class work, and one week of examinations for each division. The eighteen weeks are divided into two terms of nine weeks each, and the subjects in the Course Outlines on the following pages have been arranged by terms. Opposite these subjects will be found the number of hours of class work in recitation, laboratory or the drawing room, as well as the hours of outside preparation, that have been assigned as the minimum weekly required amount for each subject.

The number in parenthesis, following the subject in the "Outlines of Courses," is the number by which that subject is identified in the descriptive matter under "Subjects of Instruction"

The work is so planned that the student will be required to spend from 50 to 60 hours, in preparation and class work, during each school week.

When a student elects a course, he is required to complete all subjects in that course, not indicated as "Optional," in order to receive a diploma. No subject is to be dropped, or omitted, without the consent of the Dean.

CIVIL ENGINEERING

The purpose of this Course is to give the student a broad education in those subjects which form the basis of all branches of technical education, and a special training in those subjects comprised under the term "Civil Engineering." It is designed to give the student sound training, both theoretical and practical, in the sciences upon which professional practice is based.

Civil Engineering covers such a broad field that no one can become expert in its whole extent. It includes Topographical Engineering, Municipal Engineering, Railroad Engineering, Structural Engineering, and Hydraulic and Sanitary Engineering. It covers land surveying, the building of railroads, harbors, docks and similar structures; the construction of sewers, waterworks, roads and streets; the design and construction of girders, roofs, trusses, bridges, buildings, walls, foundations and all fixed structures. All of these branches of Engineering rest, however, upon a relatively compact body of principles, and in these principles the students are trained by practice in the class room, drawing room, the field and the testing laboratory.

The course is designed to prepare the young engineer to take up the work of assisting in the design and construction of structures; to aid in the location and construction of steam and electric railways, sewerage and water supply systems; and to undertake intelligently supervision of work in the allied fields of mining, architectural and electrical engineering, and general contracting.

I. CIVIL ENGINEERING

FIRST YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Mathematics I. a (10)	6	6	Mathematics I. b (10)	6	6
Physics I., Lect. and Rec. (20)	4	4	Physics I., Lect. and Rec. (20)	4	4
Physics I., Laboratory (21)	2	0	Physics I., Laboratory (21)	2	0
Descriptive Geometry I. (42)	4	1	Descriptive Geometry I. (42)	4	1
Mechanical Drawing (40)	6	0	Mechanical Drawing (40)	6	0
Engineering Computations (14)	3	0	Engineering Computations (14)	3	0
English I. (1)	3	3	English I. (1)	3	3
Surveying I. (50)	2	3	Surveying I. (50)	2	3
Surveying I., Field and Plot (51)	6	0	Surveying I., Field and Plot (51)	6	0
Engineering Conference (201)	1	0	Engineering Conference (201)	1	0

SECOND YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Surveying II. (52)	2	2	Surveying II. (52)	2	2
Surveying II., Field & Plot (53)	6	0	Surveying II., Field & Plot (53)	6	0
Topographical Drawing (54)	2	0	Topographical Drawing (54)	2	0
Applied Mechanics I. (30)	3	4½	Applied Mechanics I. (30)	3	4½
Physics II., Lect. and Rec. (22)	3	3	Physics II., Lect and Rec. (22)	3	3
Physics II., Laboratory (23)	2	0	Physics II., Laboratory (23)	2	0
Mathematics II., (11)	5	7½	Mathematics II. (11)	5	7½
Elementary Electricity (126)	2	2	Elementary Electricity (126)	2	2
Descriptive Geometry II. (43)	2	0	Descriptive Geometry II. (43)	2	0
Mechanism (90)	3	3	Precision of Measurements (13)	1	1
Engineering Conference (201)	1	0	Geology (160)	2	2
			Engineering Conference (201)	1	0

THIRD YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Railroad Curves (57)	3	4½	*Railroad Curves (57)	3	4½
Railroad Eng. Field & Draw(58)	6	0	§Railroad Earthwork (57A)	3	4½
Mathematics III. (12)	2	2	Railroad Eng. Field & Draw.(58)	6	0
Structural Drawing (73)	3	0	Theory of Structures (70)	3	4½
Applied Mechanics II. (31)	3	4½	Structural Drawing (73)	3	0
Hydraulics (110)	3	4½	Applied Mechanics II. (31)	3	4½
Applied Electricity L.&R.(134)	2	2	Hydraulics (110)	2	3
Applied Electricity Lab. (135)	3	2	Applied Electricity L.&R.(134)	2	2
Heat Engineering-Thermodynamics (95)	3	4½	Applied Electricity Lab. (135)	3	2
Engineering Conference (201)	1	0	Heat Engineering-Thermodynamics (95)	3	4½
			Engineering Conference (201)	1	0

FOURTH YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Structural Design (74)	6	0	Structural Design (74)	6	0
Theory of Structures (71)	5	10	Theory of Structures (71)	5	10
Advanced Structures (72)	2	3	Advanced Structures (72)	2	3
Concrete Construction (80)	2	2	Concrete Construction (80)	2	2
Concrete Design (80A)	3	0	Concrete Design (80A)	3	0
Highway Engineering (56)	2	2	Foundations (82)	2	2
Materials (81)	3	3	Sanitary Engineering (112A)	3	3
Hydraulic Engineering (112)	3	3	Testing Materials Lab. (34)	2	0
Engineering Conference (201)	1	0	Engineering Conference (201)	1	0
Thesis	3	0	Thesis	6	0

* First three weeks.
§ Last six weeks

MECHANICAL ENGINEERING

This course is designed to give a broad foundation in those fundamental subjects which form the basis for all professional engineering practice, and to especially equip the young engineer with a thorough knowledge of the various phases of Mechanical Engineering. The course embraces instruction by text-book, lecture, laboratory and work-shop practice, with special references to the following branches: Steam Engineering, Hydraulic Engineering, Power Plant Design, Machine Design, Applied Electricity, Heat Engineering, and allied fields of the engineering profession.

The course affords training in the methods, and gives practice in the process of Construction, which develops in the student the capacity for thinking along mechanical lines, thus enabling him to base all of his work upon fundamental principles already learned, rather than upon empirical rules. It is the endeavor to give the student a thorough theoretical training and meanwhile devote sufficient time to the practical work, so that he may become a proficient mechanical engineer, both in theory and in practice, in all of the various branches of Mechanical Engineering previously mentioned.

II. MECHANICAL ENGINEERING

FIRST YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Mathematics I. a (10)	6	6	Mathematics I. b (10)	6	6
Physics I., Lect. and Rec. (20)	4	4	Physics I., Lect. and Rec. (20)	4	4
Physics I., Laboratory (21)	2	0	Physics I., Laboratory (21)	2	0
Descriptive Geometry I. (42)	4	1	Descriptive Geometry I. (42)	4	1
Mechanical Drawing (40)	12	0	Mechanical Drawing (40)	12	0
Engineering Computations (14)	3	0	Engineering Computations (14)	3	0
English I. (1)	3	3	English I. (1)	3	3
Engineering Conference (201)	1	0	Engineering Conference (201)	1	0

SECOND YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Mechanism (90)	3	3	Mechanism (90)	3	3
Mechanical Eng. Drawing (91)	9	0	Mechanical Eng. Drawing (91)	9	0
Descriptive Geometry II. (43)	2	0	Descriptive Geometry II. (43)	2	0
Mathematics II. (11)	5	7½	Mathematics II. (11)	5	7½
Physics II., Lect. and Rec. (22)	3	3	Physics II., lect. and Rec. (22)	3	3
Physics II., Laboratory (23)	2	0	Physics II., Laboratory (23)	2	0
Applied Mechanics I. (30)	3	4½	Applied Mechanics I., (30)	3	4½
Elements of Electricity (126)	2	2	Elements of Electricity (126)	2	2
Engineering Conference (201)	1	0	Precision of Measurements (13)	1	1
			Valve Gears (90)	1	2
			Engineering Conference (201)	1	0

THIRD YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Heat Engineering: Thermo. (95)	3	4½	Heat Engineering Thermo. (95)	3	4½
Boilers (95)	2	1	Boilers (95)	2	1
Applied Mechanics II. (31)	3	4½	Applied Mechanics II. (31)	3	4½
Machine Drawing (92)	9	0	Machine Drawing (92)	9	0
Hydraulics (110)	3	4½	Hydraulics (110)	2	3
Applied Electricity Lect. (134)	2	2	Applied Electricity Lect. (134)	2	2
Applied Electricity Lab. (135)	3	2	Applied Electricity Lab. (135)	3	2
Mathematics III. (12)	2	2	General Metallurgy (147)	2	1
Engineering Conference (201)	1	0	Foundry Practice (99)	1	0
			Engineering Conference (201)	1	0

FOURTH YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Machine Design, Statics and Dynamics (93)	9	3	Machine Design, Statics and Dynamics (93)	12	3
Applied Mechanics III. (33)	2	2	Testing Materials Lab. (34)	2	0
Engineering Laboratory (97)	3	0	‡Engineering Laboratory (97)	3	0
Power Plant Design (96)	3	0	Hydraulic Motors (111)	3	4½
Factory construction and Management (104)	3	0	Power Plant Design (96)	3	0
Boiler Design (100)	3	0	Factory Construction and Management (104)	3	0
Journals and Reports (105)	1	3	§Surveying I., A (50A)	3	0
Principles of Illumination (132)	2	2	Journals and Reports (105)	1	3
Concrete Construction (80)	2	2	Concrete Construction (80)	2	2
Materials (81)	3	3	Foundations (82)	2	2
Engineering Conference (201)	1	0	Engineering Conference (201)	1	0
Thesis	3	3	Thesis	6	3
Machine Work (103) (Elective)	3	0	Machine Work (103) (Elective)	3	0
Forging, Chipping and Filing (101) (Elective)	2	0	Forging, Clipping and Filing (101) (Elective)	2	0
Woodworking and Pattern Making (102) (Elective)	3	0	Woodworking and Pattern Making (102) (Elective)	3	0

‡First three weeks only.
§ For three weeks only.

ELECTRICAL ENGINEERING

Electrical Engineering having in recent years developed along lines demanding a thorough appreciation of physical theory, as well as a broad working knowledge of Mathematics, it is essential that students planning to take this course should realize the fundamental necessity of obtaining a solid grounding in these subjects upon which to build.

It is not the purpose of the course to attempt the impossible aim of turning out fully trained engineers in the various branches of the science, especially as it is becoming daily more and more differentiated and specialized; but rather to lay a broad and thorough foundation for future progress along the lines of work which may particularly appeal to the individual, by giving him a good working acquaintance with the essential principles which underlie each of the more specialized branches of professional activity. Parallel with the theoretical work, runs a carefully planned course of laboratory work which is intended to develop the student's powers of accurate observation, of planning work and methods for himself, with due regard to saving of time and precision of results. For more detailed matters the reader is referred to the description of the several courses and subjects of instruction.

III. ELECTRICAL ENGINERING

FIRST YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Mathematics I. a (10)	6	6	Mathematics I. b (10)	6	6
Physics I., Lect. and Rec. (20)	4	4	Physics I., Lect. and Rec. (20)	4	4
Physics I., Lab. (21)	2	0	Elements of Electricity (126)	2	2
Elements of Electricity (126)	2	2	Elements of Elec. Lab. (127)	2	2
Descriptive Geometry I. (42)	4	1	Descriptive Geometry I. (42)	4	1
Mechanical Drawing (40)	9	0	Mechanical Drawing (40)	9	0
English I. (1)	3	3	English I. (1)	3	3
Engineering Computations (14)	3	0	Engineering Computations (14)	3	0
Engineering Conference (201)	1	0	Engineering Conference (201)	1	0

SECOND YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Direct Current Machinery (128)	6	6	Direct Current Machinery (128)	6	6
Direct Current Machinery I., Lab., and reports (122A)	7	3	Direct Current Machinery I., Lab., and Reports (122A)	7	3
Mathematics II. (11)	5	7½	Mathematics II. (11)	5	7½
Physics II., Lect. and Rec. (22)	3	3	Physics II. Lect. and Rec. (22)	3	3
Physics II., Lab. (23)	2	0	Physics II., Lab. (23)	2	0
Mechanism (90)	3	3	Precision of Measurements (13)	1	1
Machine Drawing (92)	3	0	Mech. Eng. Drawing (91)	3	0
Engineering Conference (201)	1	0	*Survey I. A. (50A)	3	0
			Engineering Conference (201)	1	0

THIRD YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Alternating Currents, Lect., Rec. and Problems (138)	4	4	Alternating Currents, Lect., Rec. and Problems (138)	6	6
Elec. Meas. Lect. (130A)	2	2	Elec. Meas. Lect. (130A)	2	2
Elec.Meas.Lab.and Rep.(130B)	3	3	Elec.Meas.Lab.and Rep.(130B)	3	3
Direct Current Machinery II., Lab. and Reports (122B)	7	3	**Direct Current Machinery II. Lab. and Reports (122B)	7	3
Mathematics III. (12)	2	2	†Alternating Currents, Lab. and Reports (138A)	7	3
Heat Eng.: Thermo (95)	3	4½	Heat Eng.: Thermo (95)	3	4½
Applied Mechanics I. (30)	3	4½	Applied Mechanics I (30)	3	4½
Engineering Conference (201)	1	0	Engineering Conference (201)	1	0

FOURTH YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Alternating Current Machinery, Lect., Rec., and Problems (139)	6	6	Alternating Current Machinery, Lect., Rec. and Problems (139)	4	4
Alternating Current Machinery, Lab. and Reports (139A)	7	4	Alternating Current Machinery Lab. and Reports (139A)	7	4
Generation, Transmission and Utilization of Power (136)	5	5	Generation, Transmission and Utilization of Power (136)	5	5
Engineering Laboratory (97)	3	3	Tech. Papers and Magazines (137A)	1	3
Hydraulics (110)	3	4½	§Engineering Laboratory (97)	3	3
Applied Mechanics II. (31)	3	4½	Testing Materials Lab. (34)	2	2
Engineering Conference (201)	1	0	Hydraulic Motors (111)	3	4½
			Engineering Conference (201)	1	0
			Thesis	12	0
			Electrical Engineering Excursions (121A) optional	3	0

*Three weeks course
**First five weeks
§First three weeks
†Last four weeks

CHEMICAL ENGINEERING

During the great industrial advance of recent years, chemical industry has been in the front rank of progress, and perhaps the most potent reason for this may be found in the replacement, by scientific guidance, of the old rule of thumb methods.

Again, owing to the keenest competition, manufacturers have been compelled to utilize every product of their plants, and this has called for skilled chemical knowledge.

The course in Chemical Engineering has, for its purpose, the training of students competent to take responsible places in the operation of industries based on chemical principles.

During their course the students are employed in chemical industries, as gas manufacturing plants, chemical engineering companies, etc., so that they not only get an excellent training in the theory of such work at school, but get a thorough familiarity with the technical side of the industry as well.

The class work includes a training in Inorganic, Analytical, Organic, and Industrial Chemistry, which is accompanied by appropriate laboratory work.

In addition to the foregoing subjects, the student is given a good knowledge of mechanical and electrical subjects, as Drawing, Applied Mechanics, Direct Current Practice, Electrical Measurements, etc., which are taken up in a way to give them especial bearing on the work of the Course.

IV. CHEMICAL ENGINEERING

FIRST YEAR

FIRST TERM	Hours per week Ex.	Prep	SECOND TERM	Hours per week Ex.	Prep.
Mathematics I. a (10)	6	6	Mathematics I. b (10)	6	6
Physics I., Lect. and Rec. (20)	4	4	Physics I., Lect. and Rec. (20)	4	4
Physics I., Laboratory (21)	2	0	Physics I., Laboratory (21)	2	0
Descriptive Geometry I. (42)	4	1	Descriptive Geometry I. (42)	4	1
Mechanical Drawing (40)	3	0	Mechanical Drawing (40)	3	0
Engineering Computations (14)	3	0	Engineering Computations (14)	3	0
English I. (1)	3	3	English I. (1)	3	3
Inorganic Chemistry (142)	4	4	Inorganic Chemistry (142)	4	4
Inorganic Chemistry Lab. (142)	6	0	Inorganic Chemistry Lab. (142)	6	0
Engineering Conference (201)	1	0	Engineering Conference (201)	1	0

SECOND YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Qualitative Analysis (143)	12	3	Quantitative Analysis (144)	12	3
Mathematics II. (11)	5	7 ½	Mathematics II. (11)	5	7 ½
Physics II., Lect. and Rec. (22)	3	3	Physics II., Lect. and Rec. (22)	3	3
Physics II., Laboratory (23)	2	0	Physics II., Laboratory (23)	2	0
Applied Mechanics I. (30)	3	4 ½	Applied Mechanics I. (30)	3	4 ½
Mechanical Eng. Drawing (91)	3	0	Mechanical Eng. Drawing (91)	3	0
Mechanism (90)	3	3	Elements of Electricity (126)	2	2
Elements of Electricity (126)	2	2	Valve Gears (90)	1	2
Engineering Conference (201)	1	0	Engineering Conference (201)	1	0

THIRD YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Organic Chemistry Lect. (145)	3	3	Organic Chemistry Lect. (145)	3	3
Organic Chemistry Lab. (145A)	6	0	Organic Chemistry Lab. (145A)	6	0
Mathematics III. (12)	2	2	General Metallurgy (147)	2	2
Applied Mechanics II. (31)	3	4 ½	Technical Analysis (148)	3	1
Heat Engineering: Thermo (95)	3	4 ½	Heat Engineering: Thermo (95)	3	4 ½
Machine Drawing (92)	3	0	Machine Drawing (92)	3	0
Applied Electricity Lect. (134)	2	2	Applied Electricity Lect. (134)	2	2
Applied Electricity Lab. (135)	3	2	Applied Electricity Lab. (135)	3	2
Hydraulics (110)	3	4 ½	German I. (170)	2	2
German I. (170)	2	2	Theoretical Chemistry Lect. (149)	2	2
Engineering Conference (201)	1	0	Engineering Conference (201)	1	0

FOURTH YEAR

FIRST TERM	Hours per week Ex.	Prep.	SECOND TERM	Hours per week Ex.	Prep.
Technical Analysis (148)	4	2	Technical Analysis (148)	4	2
Industrial Chemistry Lect. (146)	3	3	Industrial Chemistry Lect. (146)	3	3
Industrial Chemistry Lab. (146A)	6	0	Industrial Chemistry Lab. (146A)	6	0
Organic Chemistry Lect. (145)	2	2	Organic Chemistry Lect. (145)	2	2
Organic Chemistry Lab. (145A)	6	0	Organic Chemistry Lab. (145A)	6	0
Chemical Engineering (150)	3	3	Chemical Engineering (150)	3	3
Theoretical Chemistry Lect. (149)	3	3	Factory Inspection and Report Writing (151)	3	2
Theoretical Chemistry Lab. (149A)	3	0	German II. (171)	2	2
German II. (171)	3	3	Thesis	6	3
Thesis	3	3	Engineering Conference (201)	1	0
Engineering Conference (201)	1	0			

Subjects for Instruction

Instruction is given by lectures and recitations, and by practical exercises in the field, the laboratories, and the drawing rooms. A great value is set upon the educational effect of these exercises, and they form the foundation of each of the four courses. Text-books are used in many subjects, but not in all. In many branches the instruction given differs widely from available text-books; and, in most of such cases, notes on the lectures and laboratory work are issued, and are furnished to the students. Besides oral examinations in connection with the ordinary exercises, written examinations are held from time to time. At the close of the year, in May and June, general examinations are held.

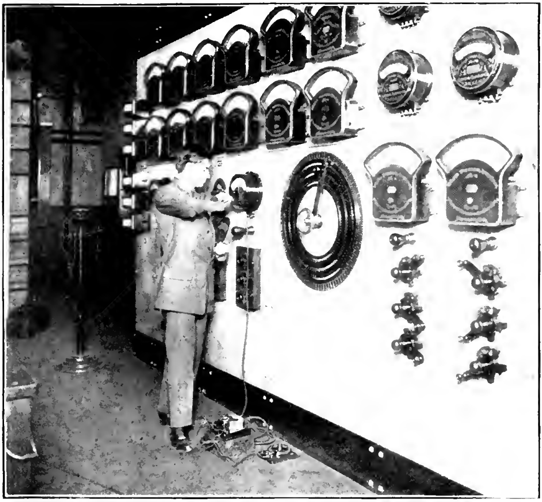
In the following pages will be found a more or less detailed statement of the scope, as well as the method of instruction, of the subjects offered in the various courses. The subjects are classified, as far as possible, related studies being arranged in sequence.

The subjects are numbered, or numbered and lettered, for convenience of reference in consulting the various Course Schedules. As the total number of hours per term devoted to a subject sometimes varies in different courses, these hours are not in every case given in connection with the following descriptions.

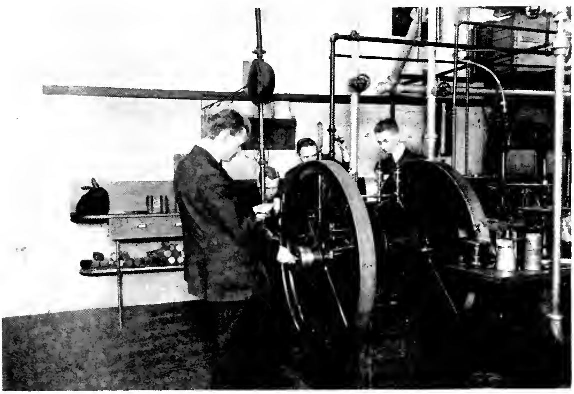
The requisites for preparation include not only the subjects specified by number, but also those required as a preparation for them. The reason for this is that to properly carry on the more advanced subjects, the student must have become proficient in all subjects necessary for a clear comprehension of the last subject. Some studies, specified as being required in preparation, may be taken simultaneously. The student must complete such subjects before starting on more advanced work.

By careful consideration of the Course Schedules, in connection with the following Description of Subjects, the applicant for a special course may select, for the earlier part of

Electrical Engineering Students

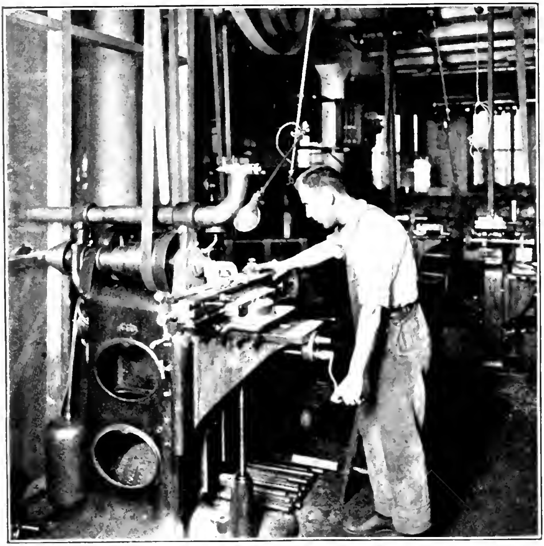


Checking Voltmeters
Head Place Station Edison Electric Illuminating Co.



Taking Indicator Diagrams of a Gas Engine
Class in Engineering Laboratory

Mechanical Engineering Students



Milling Insulator Ends
Machine Shop Boston Elevated Railway Co.

Class in Drafting
Drafting Rooms

that course, such subjects as will enable him to pursue later those more advanced subjects which he may particularly desire.

Applications for exception, for sufficient causes, from the required preparation, as stated in connection with each subject described below, will always be considered by the Dean.

The topics, included in the list which follows, are subject to change at any time by action of the School authorities.

SYNOPSIS OF COURSES

1. English I

This is a course in the principles of composition and letter writing. Special attention is given to spelling, punctuation and grammar.

The latter half of the work is devoted to writing business letters, to descriptions of processes and machinery, and to all other possible means of enabling the student to express himself with accuracy and precision, both orally and in writing.

10. Mathematics Ia

Preparation: Algebra, Geometry

Trigonometry, including circular measure, co-ordinates, trigonometric ratios, formulas, law of sines, law of cosines, law of tangents, solution of right and oblique triangles and application to problems in Physics and Engineering.

Variation, logarithms, exponential equations and the uses of formulae in Physics and Engineering.

10. Mathematics Ib

Preparation: Algebra, Geometry

Analytic Geometry, including rectangular and polar coordinates, the straight line, conics and loci problems, empirical curves and formulae, a discussion of the sine curve, and other useful curves.

11. Mathematics II

Preparation: 10

Differential and Integral Calculus, rate of increase, differentiation, determination of maxima and minima by differentiation, integration, definite integrals, determination of mean value, areas and volumes by integration, center of gravity.

12. Mathematics III

Preparation: 10, 11

A review and continuation of Mathematics II. Double and triple integration, partial differentiation, and the use of integral tables. The consideration of Differential and Integral Calculus as applied to problems in Engineering.

13. Precision of Measurements

Preparation: 10, 11

This course, which is required of all students in the second half of the second year, comprises a thorough discussion of the fundamentals of the Theory of Measurements, including a study of the Sources of Error, the Best Representative Value of the result of a series of measurements, the determination of the several Precision Measures of the result of one's work, the converse problem of how best to proceed in order to reach a given degree of precision, and a thorough consideration of the proper use of Significant Figures.

14. Engineering Computations

This course is taken by all first-year students and is an unprepared exercise coming three hours a week throughout the first year. The work covers arithmetical computations of various kinds common to engineering practice, such as addition, subtraction, division of whole and mixed numbers, problems in the use of fractions, percentage, calculations, square root, etc. The Course also includes the construction and use of the slide rule, and logarithmic computation of values in formulas which occur in engineering practice.

19. Review Mathematics

This course is given in the first year to those students who have had inadequate mathematical training previous to entering the School. The work covers Algebra and Geometry and aims to strengthen the student on his weak points. Students whose records in Mathematics I are not satisfactory may be required to take this course.

20. Physics I

The subjects considered are general mechanics, molecular mechanics, wave-motion and optics, which topics are discussed both mathematically and experimentally. It is the purpose of

the course to lay a thorough foundation for subsequent study of experimental and technical physics. Hence it is planned with immediate reference to familiarizing the pupil with the fundamental principles of the science. The lectures are illustrated by suitable experiments.

21. Physical Laboratory I

Preparation: 20

A course of experimental exercises in the first year for each student. The experiments are correlated, so far as practicable, with the lecture and class-room work, which is devoted to mechanics during the first year. The use of the various instruments of precision is taught, as far as may be, in connection with experiments, each of which illustrates some different method, or principle. The experiments include: the true weight and density of a solid, the use of the vernier, micrometers and spherometers, the inclined plane, the kinetic energy of a rotating fly-wheel, the spirit level, and specific gravities of solids by various methods.

22. Physics II

Preparation: 20

A course of experimental lectures, which is a continuation of Physics I. In this work the student completes the study of physics started in Physics I.

23. Physical Laboratory II

Preparation: 22

A series of experiments on light and heat, in the second year, correlated, as far as practicable, with the lecture course. The experiments in Optics include the use of the spectrometer, determination of the focal length and radii of curvature of lenses, indices of refraction, and elementary spectrum analysis. All work is strictly quantitative, and the attention of the student is especially directed to the precision discussion of his results.

29. Review Physics

A course covering the essentials of Physics, as taught in the best high schools, and designed to help those students who have had insufficient preparation before entering the Engineering School. Students whose record in Entrance Physics is

unsatisfactory, will be required to take this course in addition to their other work.

30. Applied Mechanics I

Preparation: 10, 11, 20, 22

The subject comprises a study of the general methods and applications of statics, including the determination of reactions, stresses in frames, of distributed forces, center of gravity, of moment of inertia and radius of gyration of plane areas and solids. Kinematics and dynamics are also taken up, including the equations for uniform and varying rectilinear and curvilinear motion, centrifugal force, pendulum, harmonic motion, rotation, combined rotation and translation, momentum and angular momentum, center of percussion, impact, work, power and kinetic energy.

31. Applied Mechanics II

Preparation: 30

This course comprises a study of the strength of materials, mathematically treated. In the first term the subjects studied are: the stresses and strains in bodies subjected to tension, to compression and to shearing; common theory of beams, with thorough discussion of the distribution of stresses, shearing forces and bending moments; longitudinal shear, slopes and deflections, and the strength of shafts and springs. In the second term a study is made of the combined stresses in beams subjected to tension and compression, as well as bending; also of the strength of hooks and columns, the design of riveted joints, and thin, hollow cylinders. A brief consideration of strains, and the relations of the stresses on different planes in a body, and the stresses in simple frames subjected to bending forces, is taken up in the latter part of the course.

33. Applied Mechanics III

Preparation: 31

A course treating of the laws of friction, including a study of the distribution of friction on shaft journals and pivots; also a study of the transmission of power by belting and by ropes, and of the friction reducing power of lubricating oils.

34. Testing Materials Laboratory

Preparation: 31

The work done by the students in the Testing Materials Laboratory includes tests to determine the elongation, reduction of areas, modulus of elasticity, limit of elasticity, yield point, ultimate tensile strength, and ultimate compressive strength of metals, such as steel, cast iron, copper and brass; tensile and compressive tests on timber and concrete; tests to determine the deflection, modulus of elasticity, elastic limit, and ultimate transverse strength of steel and wooden beams, subjected to transverse loads. Tests are also made on cement mortars to determine the strength of cubes and briquettes at different ages.

40. Mechanical Drawing

This course extends throughout the first year, and is taken by all first-year students. The work is planned on the assumption that the student has had no experience in the use of drafting instruments, and so at the start he is taught the mechanical processes involved in the use of the various instruments. Then he takes up line work, use of French curve, geometrical constructions, tracing and simple projection work.

A student who has completed work equivalent to the course before entering the School may, upon presentation of his plates and the passing of a satisfactory examination, be excused from the work at the discretion of the instructor in charge.

42. Descriptive Geometry I

The course covers the simpler problems on the point, line and plane and various constructions in the projection of solids, including sections and developments.

In the latter half of the course the problems on the line and plane are completed, and the projection of solids is continued through the intersection of solids bounded by plane faces. Isometric drawings and several practical applications are given.

43. Descriptive Geometry II

Preparation: 42

The course is a continuation of Descriptive Geometry I, and deals with single and double curved surfaces; their intersection by oblique planes; tangent planes, penetrations, de-

velopment, and so forth. Various practical problems are given to illustrate the applications of the principles studied.

50. Surveying I

Preparation: 10, 11

This course consists of two lectures, or recitations, per week during the first year. The student is taught the theory of the various instruments used in plane surveying, including the chain, tape, compass, transit and level; the method of carrying out various surveys, the computation of area, and the application of contour maps to the solutions of problems of drainage, road location, landscape engineering, etc.

50a. Surveying Ia

This is a brief course for students taking Courses II and III, to give them instruction in the essential principles of surveying practice, including the use of the transit, level, and other surveying instruments.

51. Surveying I (Fieldwork and Plotting)

Preparation: 50

This course is taken simultaneously with Surveying I, and consists of six hours of exercise per week, throughout the first year. The student is taught the use of the chain, tape, compass, transit and various forms of leveling instruments in the field. The work in the drawing room consists in making scale drawings of a compass survey, transit survey, and the layout of a city block, by the methods adapted to the plotting of these various surveys.

52. Surveying II

Preparation: 50, 51

This course is a continuation of Surveying I, and consists of two lectures, or recitations, per week, throughout the second year. The student is taught the theory of the stadia and plane table in topographic surveying, adjustments of the transit and level, the methods of making triangulation surveys, astronomical observations, and of conducting city, mine, mountain, and photographic surveys.

53. Surveying II (Fieldwork and Plotting)

Preparation: 52

This course is taken simultaneously with Surveying II, and

consists of six hours of exercise per week throughout the second year. The fieldwork is given over to the making of stadia surveys, the use of the sextant and the barometer, the determination of the true meridian by observations on the sun and on Polaris, and the practice of plane table surveying. In the drawing room a stadia reduction diagram is first made, and later a plot of a topographical survey is made from notes taken in the field. The student is also taught the method of making plots from mine surveyor's notes; plots of photographic surveys, and he is required to make the necessary computations, drawings and profiles for the location of a highway on a contour map.

54. Topographical Drawing

Preparation: 50, 52

This course consists of two hours of exercise per week throughout the year. A study is made of the different topographical signs used in making surveying maps. Each student is required to make a number of plates of each kind of topography, and to become reasonably proficient in the making of topographical maps.

56. Highway Engineering

Preparation: 57

This course consists of two lectures, or recitations, a week, during the first term of the fourth year. The subjects considered are the location, construction, and maintenance of roads, street design, and street drainage, sidewalks, pavement foundations, and the construction, cost and maintenance of the various kinds of pavements, including asphalt, brick, cobble-stone, stone-block, and wood-block. The consideration of automobile roads and concrete pavements is also taken up.

57. Railroad Curves

Preparation: 50, 51, 58

This course consists of three hours of exercise a week throughout the first twelve weeks. A study is made of the mathematics of the various curves used in engineering, with their application to the location of railroads, highways, sewers, pipe lines, etc. A study is also made of the spiral easement curve.

57a. Railroad Earthwork

Preparation: 57

This course is a continuation of Railroad Curves, and consists of three exercises a week, for the last six weeks of the school year. The course is designed to give the student a good working knowledge of the various methods of staking out and computing earthwork, especial attention being paid to railroad cross-sections.

58. Railroad Fieldwork and Drawing

Preparation: 57

This course consists of six hours of exercise a week throughout the third year. In the fall fieldwork, a reconnoissance is first made of a railroad about a mile and a half in length, followed by a preliminary survey, with transit and level, for the determination of contours, as a basis for fixing the location survey. All this work follows modern practice in laying out railroads. The fieldwork in the spring is devoted to a systematic drill in running in curves of various kinds, including transition curves, and in staking out earthwork. The drawing consists in plotting up the preliminary survey of the railroad surveyed.

70. Theory of Structures

Preparation: 31

This is a course of twenty-seven exercises in the second term of the third year, devoted to class and drawing-room work, in studying the loads, reactions, shears, and moments acting upon structures of various kinds, as roofs and bridges. A thorough study is also made of the various functions of the influence line; the methods used to determine the position of moving loads to produce maximum shears and moments on bridges and the design of beams and girders and moments on bridges. A study is also made of the practical design of beams and girders.

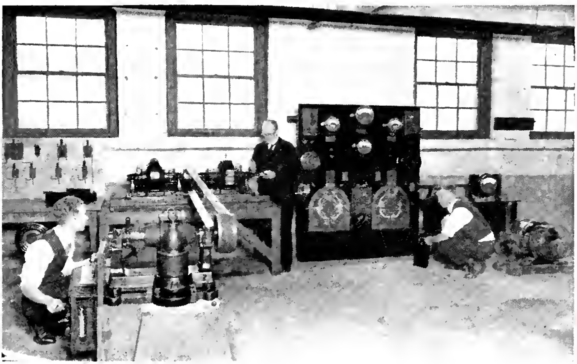
71. Theory of Structures, Bridges and Similar Structures

Preparation: 70

This course treats of the computation and design of structures of wood, steel and masonry, by analytical and by graphical methods. The subjects considered are: the plate girder,

Electrical Engineering Students

Winding Armatures
Armature Shop — Boston Elevated Railway Co.



Determining the Characteristics of Shunt-wound Generators
Operated in Parallel
Electrical Engineering Laboratory

Civil Engineering Students

Locating Walls of a Building
Aspinwall and Lincoln, Civil Engineers

Group of Civil Engineering Students

roof and bridge trusses of various types, such as simple trusses, bridge trusses with secondary web systems, including the Baltimore and Pettit trusses, and trusses with multiple web systems, lateral and portal bracing, transverse bents, viaduct towers and cantilever bridges. A study is also made of the design of columns, tension members, pin and riveted truss joints, trestles of wood and steel, and arches of metal and stone. In the latter part of the course the student is given training in the use of the standard handbooks in structural work. The object is to train the student thoroughly in the application of mechanics to the design of structures.

72. Advanced Structures

Preparation: 71

This course consists of a thorough study of graphical statics, deflection and camber, continuous girders and movable bridges, after which it treats of the computation and design of retaining walls, masonry dams and masonry arches. Only the more simple cases are considered.

73. Structural Drawing

The course in structural drawing consists of one exercise of two hours each week throughout the third year in the drawing room, devoted to the drawing of standard sections of structural steel shapes and connections, and the preparation of drawings representing elementary structural details. This course is designed to familiarize the student with the conventional signs for riveting, riveted connections and the dimensioning and detailing of structural parts.

74. Structural Design

Preparation: 72

A course of six hours per week throughout the fourth year, in which the students are instructed in the design of structures of wood, stone and metal. Each student is given a set of data, and is required to perform all the computations and to make designs and working drawings for structures, such as railroad bridges and roof trusses. His work is criticized as it progresses.

80. Concrete Construction

Preparation: 72

A course consisting of lectures and drafting, in which instruction is given in the theoretical and practical principles involved in the design of structures of plain and reinforced concrete. The course includes a study of the simple reinforced concrete beam, the design of slabs, T-beams, columns and footings. Instruction is given by means of lectures and text-books, in conjunction with which each student is given practical problems in design to be worked out in the drawing room.

80a. Concrete Design

A course of three hours per week throughout the fourth year, in which students are given instruction in the design of structures of concrete, plain and reinforced. Each student is given a set of data, and is required to make all computations and to make designs and working drawings for several concrete structures, including a masonry dam, plain concrete arch, a reinforced concrete floor system, and a reinforced concrete retaining wall.

81. Materials

Preparation: 72

This course consists of three lectures, or recitations, per week throughout the first term of the fourth year, in the study of methods of testing and the strength of various materials used by the engineer. A detailed study is also made of the methods of manufacturing, properties, and uses, of materials used in engineering work, such as lime, cement, concrete, brick, wood, stone, iron and steel. Each student is also required to prepare, and present to the class, a paper on some subject of especial importance, which is assigned by the instructor.

82. Foundations

Preparation: 71

A course of two lectures a week during the second half of the fourth year. The subjects treated in this course are pile foundations, including those of timber and concrete, sheet piles, coffer-dams, box and open caissons, pneumatic caissons, pier foundations in open wells, bridge piers and abutments,

and spread foundations. A study is also made of the bearing power of different kinds of soils, and the examination of the site.

90. Mechanism and Valve Gears

Preparation: 11, 40, 42

This course includes a systematic study of the motions and forms of the various mechanisms occurring in machines, and the manner of supporting and guiding the parts.

The latter part of this work is devoted to a discussion of the fundamental systems of gearing, together with their applications and limitations.

The theory and practice of designing valve gears for steam engines, including the plain slide valve, link motions, radial valve gears, double valves and drop cut-off valves are also studied.

91. Mechanical Engineering Drawing

Preparation: 40, 90

In this course the student makes drawings showing the application of simple machine details, such as bolts and nuts, screws, springs, keys, flanges, pipe fittings, etc.; systems of dimensioning, conventional representations, and blue printing are also taught. The larger part of the work consists of drawing, illustrating the class-room work in connection with the courses in Mechanism and Valve Gears, including the design of cams, gear teeth, slide valves, double valves, etc.

92. Machine Drawing

Preparation: 91

The aim of the course is to teach the proper way of making the necessary dimensioned drawings for use in practice, good shop systems being adopted. The instruction includes the making of working detail and assembly drawings of machinery from measurements.

93. Machine Design, Statics and Dynamics

Preparation: 91, 31

The main object of the course is the application of principles already learned to the solution of problems in design. For each design the constructive details are carefully discussed; each student then makes all the necessary calculations to de-

termine the dimensions of every part, and finally he completes the working drawings. The scope of the designs is such as to include most of the elementary principles of design, and yet is sufficiently limited to enable the student to complete every detail, as it is believed that only by such thorough work can real benefit be obtained.

The work in Dynamics includes a number of the principal applications of Dynamics to moving machinery, such as governors, fly-wheels, the action of the reciprocating parts of the steam engine, running balance, whirling speed of shafts, etc. The work is supplemented by a course in drafting.

Problems of both static and dynamic nature are given, illustrative of the principles studied.

Many problems, illustrating the methods of determining the stresses in machine parts, are given in connection with the course.

95. Heat Engineering: Thermodynamics and Boilers

Preparation: 10, 11, 31

The course includes a study of the principles of thermodynamics; a dicussion of the properties of gases, saturated and superheated vapors, especially of air and steam; of the flow of fluids through orifices, nozzles, pipes and meters, a discussion of the action of the steam injector; a study of the various cycles of the hot air, internal combustion and steam engines, of the turbine, air compressor and refrigerator systems. These engineering applications are treated from the physical, analytical and graphical points of view, so as to give the student a good foundation in the principles of thermodynamics, in the solution of actual heat engineering problems. The course also includes a study of the simple, compound and multiple expansion steam engine, of the different types of gas engines, of the gas producer, of compressed air and refrigerator machines, and the methods of testing such machines.

The various types of steam boilers, with their advantages and applications as regards construction, installation and operation, form the latter part of the course. Steam turbines are also discussed.

96. Power Plant Design

Preparation: 31, 93, 95

The course consists largely of drawing-room work and calculations, with such lectures as may be needed from time to time. The work of the course consists in making the working drawings necessary to show the location of boilers, engines, auxiliaries, piping, coal pockets, etc., for a power house, and also drawings and calculations of some of the details.

97. Engineering Laboratory

Preparation: 95

This course consists of exercises and tests upon the various forms of appliances in use in the power plant, such as:

Setting Plain Slide Valves, Riding Cut-off Valves, Corliss Valves, etc.

Analysis of Flue Gases.

Calibration of Pressure and Vacuum Gauges.

Calibration of Orifices and Nozzles.

Flow of water over weirs and through a Venturi Meter.

In addition to the foregoing, exercises are given on the Steam Calorimeter, Flow of Steam, Air Fans and Blowers, Flow of Air, Smoke Observations, Steam Boiler Testing, and Steam Engine Indicator Practice.

99. Foundry Practice

A lecture course, in which is studied the general principles and practice of pattern making, and taking up a consideration of sands, tools, molds, cores, ramming, venting, facing, spruing, risers, gateing, use of chills and simpler types of sweep molding.

100. Boiler Design

Preparation: 95

This course is devoted to a consideration of the most modern methods of boiler designing and construction. In connection with the lectures, the student is required to make calculations and drawings necessary in the design of some approved type of boiler.

101. Forging, Chipping and Filing

This course consists of one two-hour exercise per week, or its equivalent. In the forging work the student is instructed

in the building and care of fires, heating, drawing, bending, upsetting and welding.

The exercises in Chipping and Filing give instruction about the various tools and files used, and then the student is given practice in their use by various problems in chipping chamfers, keyways, etc.; and then in filing problems, as parallel surfaces, filing to template, slide and drive fits, etc.

102. Woodworking and Pattern Work

This is a course designed to give students facility in the common operations of carpentering and cabinet work, together with the use and care of woodworking machinery, as lathes, saws, planers, etc. The course includes instruction in Woodturning, having special application to Pattern-work, an illustrated discussion of the principles of molding, to explain clearly and show reasons for "Draft" on patterns and methods of allowing it, instruction in the use and making of coreboxes, and methods of building up patterns.

103. Machine Work

This course is to train students in the common operations of metal working, as chipping and filing, forging and machine work, as that done on lathes, drill presses, shapers and milling machines.

104. Factory Construction and Management

This course embraces a study of the types of buildings used for manufacturing purposes, and the principles of construction, covering brick and stone work, floors, columns, and roofs. The use of concrete, the principles of slow-burning construction, the methods of fire protection, and the elementary principles of shop sanitation, are considered in this course. It also includes a study of the organization and relations of the various departments of an industrial establishment, process mapping, or routing, scheduling of work, the office and engineering departments, methods of superintendence, and a brief discussion of cost accounting. Several lectures and drawing-room exercises are devoted to a study of manufacturing methods in multiple production processes as applied to such industries as gun making and automobile manufac-

ture, with the design of simple drilling, milling and broaching fixtures.

105. Journals and Reports

This course consists of three hours a week of outside reading in standard engineering publications, with one hour per week for class discussion. The course is designed to acquaint the student with general engineering literature and to enable him to read intelligently discussions upon Mechanical Engineering Practice.

110. Hydraulics

Preparation: 31

A course which is taken by all students. Both Hydrostatics and Hydrodynamics are discussed, and many practical problems are solved throughout the work.

Under Hydrostatics, the pressures on submerged areas, together with their points of application, are studied; while under Hydrodynamics, the flow of water through orifices, short tubes, nozzles, over weirs, and through pipes and open channels, is taken up for discussion.

111. Hydraulic Motors

Preparation: 110

A series of exercises, mainly recitations, based upon a text-book, so as to embrace the laws of flow in open channels, and of the dynamic pressure and work of water flowing over curved surfaces. The time is principally given, however, to a study of impulse wheels and reaction turbines, with reference to their proper construction, regulation and testing, and to the various sources of loss of energy in their operation.

112. Hydraulic Engineering

Preparation: 110

A course of three exercises a week, throughout the first term of the fourth year. The course is devoted to a study of irrigation, in which rainfall, run-off, the design and arrangement of canals and distributaries, methods of applying water to the soil, location and capacity of reservoirs, location and construction of dams, and other special works employed in this branch of engineering, are taken up for discussion. The student is instructed in the use of hydraulic diagrams to

obtain the discharge of conduits and canals, and the flow of water in open channels. Instruction is also given in the theory and practice of stream measurements, methods and instruments used in this work, and the working up and use of the data obtained.

112a. Sanitary Engineering

Preparation: 110, 112

The course in Sanitary Engineering consists of three exercises per week, in the second half of the fourth year. The first part of the course deals with sewerage systems and sewage disposal plants from an engineering standpoint. A study is made of the factors entering into the design of sewers for towns and cities, the design and construction of sewage disposal and sewage treatment plants, and the maintenance of the system. A short course in water supply is also given, in which is discussed the principles governing the quantity of water required for cities and towns, the determination of the run-off from drainage basins, the necessary storage to guarantee the necessary supply, the design of distribution systems, and the conditions affecting the quality of the water.

Note: On account of the limited amount of time which can be given to this course, the subjects can not be taken up in great detail.

121a. Electrical Engineering Excursions

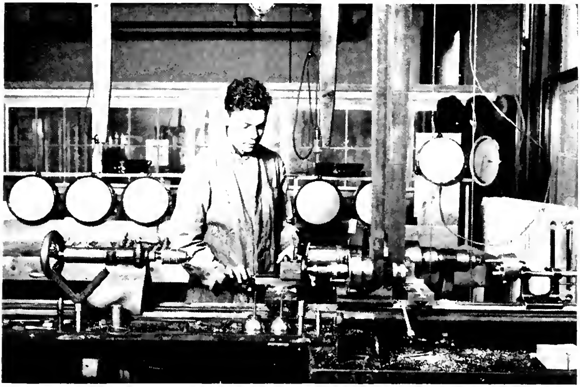
During the second term excursions are made by the third and fourth year students to some of the principal generating stations and manufacturing plants about Boston. These trips are planned and carried out by the Electrical Engineering Society to make the student more familiar with present methods of power generation and its various affiliations in the commercial field.

122a. Direct Current Machinery I, Laboratory and Reports

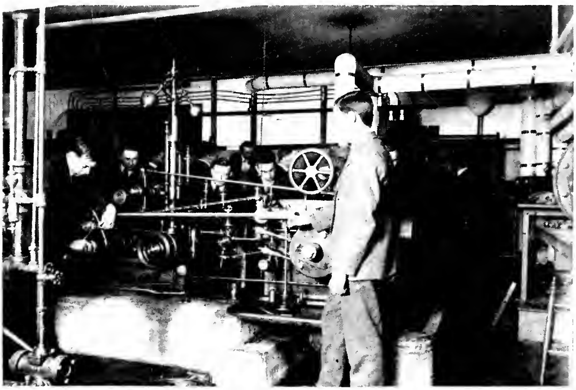
Preparation: 126

This course of exercises, given throughout the second year, is devoted to a carefully selected series of experiments, intended to exemplify qualitatively, and in the simplest manner, the principles developed in the courses on Direct Current Machines and Direct Current Practice. The purpose of the

Mechanical Engineering Students

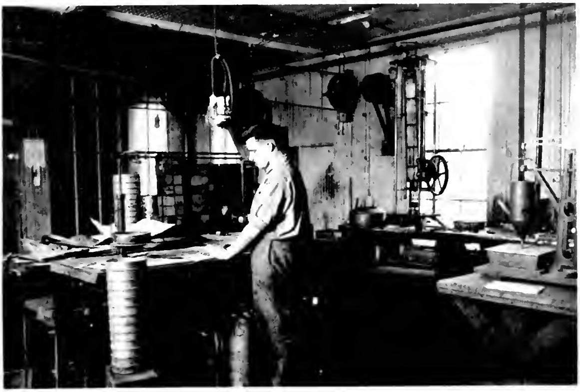


Turning Valve Parts
Sanborn Engineering Company

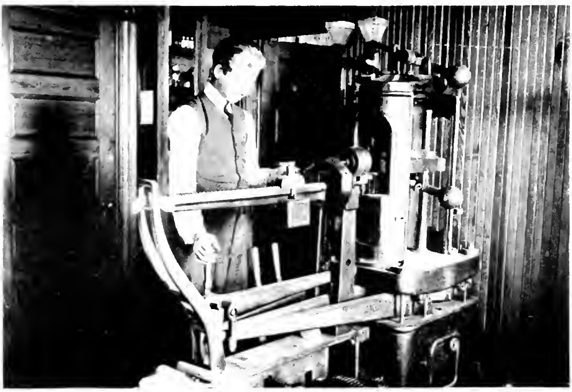


Setting Valves on a Corliss Engine
Class in Engineering Laboratory

Chemical Engineering Students



Testing Road Materials
Warren Bros.-- Paving Materials



Making Tensile Strength Tests on Cast Iron
Hunt Spiller Co.– Iron Founders

course being, in part, to develop correct methods of work, it is intended that practically the whole of the preparatory work and working up of results shall be done in the laboratory, under guidance of the instructor, so far as necessary.

The experimental work is given over to the study of the characteristics of direct current machines, involving an investigation of such matters as Characteristic Curves of different types of generators, Speed and Torque Curves of Motors, Heat Runs, etc. Then follows a series of experiments involving the testing of machines for efficiency, and as the course progresses the student is thrown more and more upon his own resources; a desired result is stated to him, and he is required to plan out his own method, settle upon the apparatus needed, solve his precision requirements, calibrate his instruments if necessary, and finally turn in a detailed report covering all phases of his work.

122b. Direct Current Machinery II, Laboratory and Reports

This course is given over to the study of the characteristics of direct current machines, involving an investigation of such matters as Characteristic Curves of different types of generators, Speed and Torque Curves of Motors, Heat Runs, etc. Then follows a series of experiments involving the testing of machines for efficiency, and as the course progresses the student is thrown more and more upon his own resources; a desired result is stated to him, and he is required to plan out his own method, settle upon the apparatus needed, solve his precision requirements, calibrate his instruments if necessary, and finally turn in a detailed report covering all phases of his work.

126. Elements of Electricity

Preparation: 10, 14, 20

This course of thirty-six exercises is taken by all students in the second year, except those in the Electrical Engineering Course, who take it in the first year. It consists of a thorough discussion of magnets and magnetism, electromagnets, magnetic field due to a current in a wire, Ohm's law, and calculations as applied to series and parallel circuits. The parts and functions of direct current machines are also studied, together

with the rheostats and starting boxes used with these machines.

127. Elements of Electricity, Laboratory

Preparation: 20, 21, 126

This course includes a series of experiments designed to illustrate the principles of electricity and magnetism. The student also becomes familiar with the use of an ammeter and voltmeter, the construction of rheostats and starting boxes, and the parts and functions of direct current machines. This course is required as preparation for all courses in the Electrical Engineering Laboratory.

128. Direct Current Machinery

This course, which is given six hours per week throughout both terms of the second year, consists of a series of lectures, recitations, and problem work, covering the general principles of direct current machinery. Beginning with the consideration of the underlying magnetic principles, there is next taken up a general consideration of the dynamo and its operating principles, followed by a discussion of armature windings, the magnetization curve, armature reaction, generator characteristics, motor characteristics, commutation, and the compensation of armature reaction, efficiency rating, heating, and generator and motor testing.

In the latter part of the course, the practical utilization of direct current machinery is considered, such as parallel running, boosters and balancers, three-wire operation, storage batteries, and the more important industrial applications of direct power supply.

130a. Electrical Measurements, Lectures

Preparation: 13, 126 and 122a

This course, given during the third year, consists of two parts; the first being intended to familiarize the student with the principal types of measuring instruments, used in both commercial work and the standardizing laboratory of the Supply Company, the manner of their use, sources of error, etc.; the second, giving the principles of the fundamental methods of measuring the several electrical quantities—Resistance, Current, Electromotive Force, Capacity, Inductance, Power and Energy.

130b. Electrical Measurements, Laboratory and Reports

Preparation: 130a

This course, given during the third year, and running parallel with 130a, consists of a series of experiments intended to bring out the principles therein developed, and involving such matters as the determination of Specific Resistance, Insulation Resistance, Conductivity, Magnetic Induction, Electrostatic Capacity, and the use of special apparatus, such as the Kelvin Bridge, Cary-Foster Bridge, Potentiometer in the calibration of voltmeters and ammeters, etc.

All through, particular stress is laid on the correct use of apparatus and methods, and precision discussions are required throughout.

132. Principles of Illumination

A course of lectures, covering the production and propagation of light, the principles of vision, and modern sources of artificial illumination. The effect on the eye of incorrect lighting, the use of diffusing, reflecting and refracting, shades and globes, the methods of determining the illumination at given points and the amount of illumination required for different types of work are also studied. Such further information as will assist the user in protecting himself from ill effects of improper lighting, as well as the correction of the fault itself, are fully discussed.

134. Applied Electricity

Preparation: 20, 21, 126

This course is a continuation of Elements of Electricity, and is given to all students in the Civil, Mechanical and Chemical Engineering Courses during the third year. The first term will be devoted to a consideration of the various direct current machines, their characteristics and applications. The second term work will cover alternating current apparatus in the same manner. Recitations and problem work will be based largely on practical applications.

135. Applied Electricity Laboratory

Preparation: 134, 126

This course parallels, in the laboratory, the work given in the above course. The laboratory work is at all times closely

related to the class-room work, and the methods of testing and operating the various machines are carefully discussed in the recitations. A written report on each experiment is required, as the ability to draw accurate conclusions from laboratory work is one of the important objects of any laboratory course.

136. Generation, Transmission and Utilization of Power

This course, given five hours weekly throughout the fourth year, begins with a careful study of the central station, both steam and hydroelectric, particular attention being given to the problems of control, protection of apparatus, switching, etc. Following this comes a thorough study of the modern high tension transmission line, potentials used, spacing of conductors, line characteristics, coronal loss, influence on neighboring circuits, quarter wave transmission and a considerable discussion of transients, power surges, etc.

After this is considered the sub-station and its apparatus and a full discussion follows of the utilization of electrical power, especial attention being given to railway operation, in its three branches of urban, interurban, and trunk line working.

Attention is also given to the matter of illumination by electric lights, and the course closes with a brief discussion of the public electrical utility and the community it serves.

137a. Technical Papers and Magazines

The purpose of this course is to give the student practice in using the Electrical Magazines and Proceedings of the Engineering Societies. The work consists of two types: in the first the student may be required to summarize from published papers, throughout a certain period, the work that has been done upon a given subject; in the second, to summarize the important matter found in a number of magazines during, say, a given month, upon various subjects; or again, he may be asked to look up a certain matter in the Patent Office Reports and report upon it.

Each report made by the student is read before the class and open for criticism by the members.

138. Alternating Currents

Preparation: 128

This course, given throughout the third year, consists of lectures, recitations, and problems on electromagnetism, electrostatics, variable currents and alternating currents. The symbolic method of treating alternating currents and three-phase circuits is thoroughly covered as a preparation for the future study of alternating current machinery.

138a. Alternating Current Laboratory

Preparation: 122b

The course consists of a series of experiments which are a preparation to the laboratory work in Alternating Current Machinery. The student becomes accustomed to using an alternating-current ammeter, voltmeter and wattmeter in making measurement in series and parallel circuits.

139. Alternating Current Machinery

Preparation: 138

This course of lectures, recitations and problems is devoted to a careful discussion of the various types of alternating current machinery. The special properties of each machine are considered for the machine as a unit, and when it is used as a part of any electrical system; some of the general considerations concerning long distance power transmission are also included. One two-hour period per week is devoted to the solution of various problems pertaining to the work.

139a. Altenating Current Machinery Laboratory

Preparation: 138, 139

The work in the laboratory covers tests of efficiency, heating, and determination of the characteristics of alternating current machinery. Certain definite results are required on each piece of assigned apparatus. A satisfactory preliminary report on the experiment is required before the student is allowed to work in the laboratory. The final results of the experiment are written in a final report, of approved form.

142. Inorganic Chemistry

Preparation: 10, 20

The fundamental principles of the science are taught in connection with the descriptive chemistry of the non-metallic

elements. The lectures are designed to precede the work of the laboratory, in which the students are expected to verify and illustrate the principles and facts which have been discussed in the lecture room. Careful manipulation, thoroughness in observation, accuracy in arriving at conclusions, and neatness in note-taking, are required of each student. The course lays the necessary foundation for subsequent chemical study.

143. Qualitative Analysis

Preparation: 142

A practical course in qualitative analysis for the separation and identification of the common metallic elements and the acids. Each student is also required to make a complete and accurate analysis of various mixtures, alloys and chemicals used in manufacturing. The laboratory work is supplemented by a course of lectures and conferences, devoted to a general study of the properties of the common metals and their compounds.

144. Quantitative Analysis

Preparation: 142, 143

A course in gravimetric and volumetric analysis. Special attention is given to accurate manipulation, the preparation of standard solutions, the calibration of instruments, and to the principles of stochiometry. In the latter part of the course some time is given to electro-analysis and to rapid methods for iron and steel. The laboratory work is supplemented by a course of lectures and conferences.

145. Organic Chemistry

Preparation: 144

A course of lectures on the principles of organic chemistry, as illustrated by the methane and benzene derivatives.

145a. Organic Chemical Laboratory

Preparation: 145

The course aims to familiarize the student with the common apparatus and general procedure used in organic work. To this end he carries out such operations as fractional distillation, extraction, crystallization, and determinations of boiling and melting points. The compounds prepared are such as to

give instruction in general methods of preparation, as oxidation, reduction, saponification, nitration and sulfonation.

The student also makes a study of the general principles of organic analysis, and carries out the quantitative determination of carbon, hydrogen, nitrogen and a halogen in organic compounds.

146. Industrial Chemistry

Preparation: 143, 144, 145

This course consists of a series of lectures and recitations upon the more important technical chemical processes, including those of Metallurgy. Much attention is given to the general operations common to many industries, such as crushing, grinding, lixiviation, filtration, evaporation, distillation, crystallization, etc., and to the details of various types of apparatus used for carrying on these processes. Some of the more important manufacturing industries, such as the production of alkali, fertilizers, glass, pigments, cement, soap, explosives, paper, as well as wood distillation, the refining of petroleum, etc., are also considered in detail.

146a. Industrial Chemical Laboratory

Preparation: 146

A course in the quantitative study of the preparation and purification of some chemical product, selected as a type of reaction of industrial importance. The processes employed are carefully controlled and the final product is analyzed to determine its purity. When the work is completed, a careful detailed report of the whole process is made and discussed in class.

147. General Metallurgy

In this course a study is made of the ferrous and nonferrous metals most used in engineering work. The production of iron, steel and the more common non-ferrous metals is taken up, and the characteristic properties of each substance are studied, together with its more common uses. Corrosion and its prevention, together with bearing metals, and the more commonly used alloys are given thorough consideration.

148. Technical Analysis

Preparation: 145

A course devoted to the following:

Analysis of gases.

Analysis of oils, mineral and vegetable.

The origin, manufacture, properties, uses and analysis of the various fuels, and the determination of the heat value of fuels by the use of a calorimetric bomb.

149. Theoretical Chemistry

Preparation: 142, 143, 144

In this course the more important principles of Theoretical Chemistry are considered; but these are treated with great thoroughness and are illustrated by applying them to a large variety of problems. The principles are further illustrated by lecture experiments. During the course the following subjects are considered: Pressure volume relations of gases and solutions, derivation of molecular and atomic weights, conductivity of solutions, ionic theory and mass action law, effect of temperature on chemical equilibrium, the laws of energy with reference to the production of heat and work, the electromotive force of voltaic cells and other electro-chemical topics.

149a. Theoretical Chemistry Laboratory

This course comprises a series of exercises to give the student a knowledge of the methods employed in molecular weight determinations, in studying the important properties of solutions. While reasonable accuracy is required, especial emphasis is laid on the underlying principles upon which all work of this character is based.

150. Chemical Engineering

The aim of this course is to train the student to get a clear comprehensive estimate of chemical engineering work, such as he may be called upon to do in the ordinary pursuit of his profession, and to deduce correct and practical inferences from his studies. To this end a carefully planned, systematic study is made of the more important operations as they are carried out in industries of a chemical nature. The various types of equipment, capable of being used for such work, are studied as well as the types which are best suited to certain kinds of work.

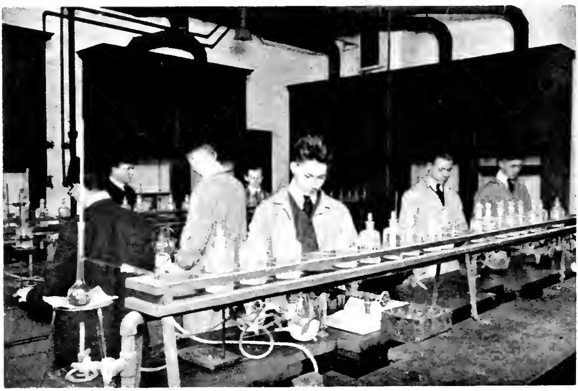
Civil Engineering Students

Locating Edge Stones
Whitman and Howard, Civil Engineers

Making a Stadia Survey
Class in Surveying Fieldwork

Chemical Engineering Students

Testing Milk
Bio - Chemical Laboratory



Class in Quantitative Analysis
Chemical Laboratory

151. Factory Inspection and Report Writing

This course consists of visits to chemical plants, and other manufacturing establishments in Boston and vicinity. After each visit, written reports upon the processes studied are submitted to the instructor and discussed in class. In writing these reports the student is expected to supplement the information obtained upon the inspection trip with that obtained from other sources, such as the technical journals and other publications. Especial attention is paid to the use of clear, though concise, English, and to the general appearance of the report.

152. Elementary Photography

This is a brief lecture and laboratory course, intended to familiarize the student with the fundamental principles and operations of photography. The construction and operation of the more common types of plate and film cameras are explained, and a few representative plates, films, and printing papers discussed. The operations of exposing and developing are discussed in some detail, together with the making of positives, both upon paper and upon lantern slides. The laboratory work consists of taking, developing, and printing pictures under the supervision of the instructor. No previous knowledge of chemistry or photography is required. The course is given at the beginning of the second term, and is optional for any student in the School.

160. Dynamical and Structural Geology

This course treats of earth movements and the various terrestrial applications of solar energy. The more important geological processes, erosion, sedimentation, deformation and eruption are taken up and discussed.

The latter part of the course is devoted to lectures on the broader structural features of the earth's crust and the application of the principles of structural geology to practical engineering problems.

170. German I

This course is planned to give the student a knowledge of German grammar, as well as a working vocabulary of scientific terms. During the course, easy scientific reading is begun.

171. German II

Preparation: 170

A continuation of German I, in which the student is given full opportunity to extend his vocabulary of technical words, as well as to become familiar with technical books and scientific articles in the current German periodicals.

200. Engineering Practice

This covers the courses in practical engineering work which the student gets with his employing firm. The exact duties performed vary with the different courses, and also vary with the firm. The students are marked for their work bi-monthly and the grades received are regularly noted on the report cards which are sent out every two months.

201. Engineering Conferences

An informal conference course of one hour per week, taken by every student in the School.

The purpose of this work is to discuss in class, under the direction of an instructor, the various duties in Engineering Practice which the students perform with the several co-operating firms. By this means, each student is enabled to profit by the work of the others, and they all are guided toward a broader viewpoint of their duties, and the relation of their individual work to that of the concern as a unit. Such subjects as problems in methods of manufacture, transportation, management, and distribution of charges, are all considered in this course.

Equipment

The school is now housed in the new building of the Association, and has very exceptionally equipped quarters for carrying on the work of the Engineering Courses.

MECHANICAL ENGINEERING DEPARTMENT

Mechanical Laboratories

Through the courtesy of the Massachusetts Institute of Technology officials, and also those of the Franklin Union, and Wentworth Institute, we are able to avail ourselves of

the unexcelled Engineering Laboratories of those Institutions for instruction purposes in the laboratory courses of the Co-operative School.

In addition to the foregoing facilities, we have several engines of our own for use for instruction, as well as the most modern equipment for gas and fuel analysis.

Our own steam engineering plant is completely equipped with meters, scales, indicators, and all the necessary accessory equipment for making complete boiler tests, and determining the efficiencies of the various appliances used in generating power, heat, and light for our new building. This places at the disposal of our classes a perfectly equipped, up-to-date, engineering department, and gives them the means of carrying on boiler tests, determining the efficiencies of various fuels and oils, taking indicator diagrams, determining the efficiency of modern reciprocating engines and turbines when direct connected to generators, as well as renders them familiar with all the various auxiliary appliances of such a plant, as condensers, pumps, air compressors, etc. The students also have the use of the equipment of our Automobile School, thus giving opportunity to study the most advanced ideas in gasoline engine practice.

Mechanic Arts Laboratories

There are at present two laboratories, one for metal work and the other for woodworking and pattern work, which are available for the use of our students.

The metal working laboratory is well equipped, and affords the student an opportunity for work with various machines, as lathes, shapers, drill presses and milling machines. There are also a gas forge and brazing furnace, together with all the required equipment for bench work instruction.

The woodworking laboratory has a power band saw, lathes, circular saw, buzz planer, and all the necessary equipment for woodworking and pattern work.

In addition to the foregoing, a small but completely equipped shop for the construction and repair of apparatus and for the use of students in connection with their thesis work has been installed. This shop is equipped with a metal and woodwork-

ing lathe, grinder, and all the necessary wood and metal-working tools. There is also a very complete set of cabinet-worker's tools for use in woodworking.

CIVIL ENGINEERING DEPARTMENT

Field Instruments

For work in the field the Department possesses various surveying instruments, representing the principal makes and types of instruments in general use. The equipment includes transits, levels, compasses, a complete plane table outfit, Locke hand level, flag poles, leveling rods, stadia rod, engineers' and surveyors' chains, steel and cloth tapes and other accessories. For higher surveying, an aneroid barometer is used for barometric leveling, and the transits are equipped with neutral glasses and reflectors for astronomical observations, as well as a sextant, reading to ten seconds, and equipped with neutral glasses and telescopes. Last year a Buff and Buff Plane Table Outfit and a Berger 18-inch Wye Level, as well as several smaller instruments, were added to the equipment.

The scope of the equipment and the field work itself are designed to train the student's judgment as to the relative merits of the various types of field instruments.

Design and Drafting Rooms

The School possesses large, light, and well-equipped drawing rooms for the carrying on of the designing and drafting, which form so important a part of civil engineering work. These rooms are supplied with lockers containing the drawing supplies, and files containing blue prints and photographs of structures that represent the best practice. Many of the prints and photographs are of structures erected in and about Boston.

ELECTRICAL ENGINEERING DEPARTMENT

The Electrical Measurements Laboratory is well equipped with apparatus for teaching the principles of measurements, and the equipment is being steadily increased and developed for the performance of a wider range of work. The special pieces of apparatus are as follows: A modified form of Conductivity Bridge, a Laboratory Wheatstone Bridge, a Leeds

and Northrup Potentiometer with volt box, standard cells and low resistance standards, and a chemical balance. A 600 ampere-hour storage battery has been added to the equipment for current tests, while for voltage work there is a high-voltage direct-current generator, having separate field excitation and speed control, for wide range of voltage adjustment.

Among the instruments used for alternating current testing are the following: Three General Electric wattmeters, constructed for Y connection; a General Electric polyphase indicating wattmeter, with double current and potential ranges; a General Electric indicating wattmeter, with double current and potential ranges, constructed for the measurement of transformer core loss, three Thomson high-torque induction watt-hour meters, with special gear trains for short-time readings; a General Electric and a Westinghouse, switchboard type, integrating watt-hour meter, and a Thomson rotating standard test meter. There is also a large number of indicating ammeters and voltmeters, and auxiliary testing apparatus, such as synchronism and frequency indicators.

For direct current testing there is a considerable number of Weston and General Electric ammeters and voltmeters of suitable ranges, and two Thomson integrating watt-hour meters.

There is also an increasing assortment of testing devices, such as speed counters, tachometers, brakes, loading resistances, and numerous minor pieces of apparatus needed in the practical operation and testing of electrical machinery.

Among the machines of this department are a pair of specially made matched machines, constructed to operate as single, two, or three phase generators, or motors, as well as synchronous converters, or double current generators. On the direct-current side, these machines will operate as shunt, series, or compound generators, either two or three wire, or as shunt, series, or compound motors. There is also a 15 H. P. Westinghouse compound motor, a 3 K. W. compound generator, two one-half H. P. series motors, a one-half H. P. shunt motor, and a 1 K. W. series generator. During the past year

there has been added a 5 H. P. General Electric interpole motor, a 5 H. P. General Electric series motor, a 4 H. P. shunt motor, two 3 H. P. shunt motors, and a 2 H. P. shunt motor.

There is also a 7½ kv-a. special General Electric alternator driven by a 10 H. P. General Electric interpole motor, and a 5 kv-a. Holtzer-Cabot alternator driven by a 10 H. P. Fort Wayne shunt motor. This latter machine has two special rotors, permitting its use as a squirrel-cage or phase-wound, induction motor. In addition, there is a 5 K. W. Holtzer-Cabot three-phase synchronous convertor, a 5 H. P. General Electric induction motor, which can be operated two or three phase, a 45 kv-a. single phase alternator, giving practically a pure sine wave, and three General Electric transformers, each of 3 kv-a. caacity. During the past year there has been added three special 1 K. W. single-phase transformers, each of 3 kv-a· capacity. During the past year various types of transformer primary and secondary con--nections.

There is also available for advanced instruction, in co-operation with the Mechanical Engineering Department, the four three-wire generators in the main generating plant. Two of these generators are driven by Ridgeway reciprocating engines and two by Westinghouse-Parsons turbines.

DEPARTMENT OF PHYSICS

There is a large laboratory devoted entirely to Physics, together with a lecture room.

The Physics Department has been very completely equipped with all necessary apparatus for the experimental work that is required of the students, as well as that required for lecture demonstration. Among other things have been added. verniers, levels, spherometers, calorimeters, thermometers, pyrometers, a spectroscope, a microscope, a spectrometer, balances, standard gram weight, lecture table galvanometer, optical disk with all accessories, lenses, photometer, a full set of Weather Bureau apparatus, including a barograph, thermograph, hygrometer, barometer, maximum and minimum thermometers, etc. These, in addition to the equipment already owned, give a wide range to the experimental work that can be done.

DEPARTMENT OF CHEMISTRY

This Department is completely equipped in all respects for carrying on all lines of Chemical work, from that of a high school to that of most advanced college grade. The three laboratories, with accommodations for over one hundred and fifty students, are very exceptionally furnished with all the necessary appliances for chemical work. Some of these are: hoods, drying closets, still, steam and hot water baths, electrolytic circuits, vacuum and pressure apparatus, balances, combustion furnaces, complete sets of apparatus for the sampling and analysis of flue gases and fuels. There are also testing machines for oils, viscosimeters, and different sorts of flash point apparatus. A chemical museum is connected with this Department where are kept specimens for purposes of illustration.

LIBRARIES

There is in connection with the School, a professional library containing books pertaining to both the school work of the students and to their practical work. In addition to this there also are current periodicals on engineering and scientific subjects for their exclusive use. All members of the School are entitled to take books from the Boston Public Library, and this offers a very unusual opportunity to our non-resident students.

DEPARTMENT OF PHYSICAL TRAINING

Our new gymnasium with all the latest modern equipment gives ample accommodation for all students.

There is a running track on the grounds adjoining, together with tennis and hand ball courts; also a large natatorium where swimming is taught by competent instructors.

In connection with this Department there are also six excellent bowling alleys, which may be used by the students upon the payment of a nominal fee.

For all further information, write

THE CO-OPERATIVE SCHOOL OF ENGINEERING,
316 Huntington Ave., Boston, Mass.

REGISTER OF STUDENTS

Name	Course	Home Address
Atkinson, Francis Richard	C. E.	*Kendall Green*
Atkinson, Sydney Marland	Ch. E.	*Natick*
Aurslanian, Meshac Harry	E. E.	*Newburyport*
Bagloe, Harry Mason	C. E.	*West Mansfield*
Bailey, Chester French	C. E.	*Amesbury*
Baldwin, Wallace Edwin	C. E.	*Everett*
Barron, George Clarence	E. E.	*Foxboro*
Bell, Thomas James	E. E.	*Newburyport*
Bird, Whitworth Fontaine	Ch. E.	*Marlborough*
Black, Robert Duncan	Ch. E.	*White Hall, Md.*
Blackwell, Lawrence Franklin	Ch. E.	*Plainville*
Bowden, George William	E. E.	*Beverly*
Boyer, Harold Alexander	C. E.	*Middlefield*
Brown, Arthur Howard	M. E.	*Everett*
Bryant, Albert Ray	M. E.	*Petersham*
Burrell, Laurence Keith	Ch. E.	*East Bridgewater*
Butter, Max Ralph	Ch. E.	*Dorchester*
Butterfield, Fiske Henry	E. E.	*Ayer*
Capen, Bernard Hayden	Ch. E.	*Stoughton*
Caulkins, Charles Whitney	Ch. E.	*Littleton*
Cikinsky, Harry	C. E.	*Roxbury*
Clapp, Harold Irving,	M. E.	*Framingham*
Clough, Erving Harlow	C. E.	*Medway*
Cole, Herbert Norman	M. E.	*Pride's Crossing*
Conkey, James Orville	E. E.	*Hardwick*
Constantine, Lawrence Henry	Ch. E.	*Salem*
Cook, Horace Sayward	M. E.	*Hamilton*
Cook, Walter Mitchell	E. E.	*Somerville*
Cooper, Raphael Dunham	M. E.	*Gloucester*
Cornell, Laurence Merritt	C. E.	*Stoughton*
Craft, Max Ralph	Ch. E.	*Dorchester*
Curtis, Edgar Hazen	M. E.	*Medford*
DeCoster, Philip James	C. E.	*Roxbury*
Dickson, Herbert Farwell	M. E.	*Harvard*
Doliber, Irving Eustis	C. E.	*Marblehead*
Douglas, Angus Dearborn	C. E.	*Cambridge*
Durkee, Lester Stephen	M. E.	*South Hamilton*
Eklund, Rolf Emel	Ch. E.	*Medford*
Evans, Forrest Dennett	E. E.	*Brighton*
Facey, Edwin Thomas	E. E.	*Duxbury*
Fader, James Harold	M. E.	*Cambridge*
Fagan, Philip Maurice	C. E.	*Roxbury*
Field, William Stuart	E. E.	*Marlborough*
Fleming, Carl Leon	C. E.	*Waltham*
Flood, Frank Lee	C. E.	*Framingham*
Fowler, Albert Edwin, Jr.	Ch. E.	*Newburyport*
Freeman, Harry Johnson	E. E.	*Dorchester*
Fuller, Nelson Munroe	M. E.	*Boston*
Fuwa, Tyler	Ch. E.	*Georgetown*
Goldman, Sam	C. E.	*Dorchester*
Greenberg, Samuel	Ch. E.	*Dorchester*
Grinnell, Elliott Seabury	Ch. E.	*Plainville*
Griswold, Harold Maurice	M. E.	*Wallingford, Conn.*

Name	Course	Home Address
Harding, Channing Turner	Ch. E.	*Medway*
Haven, Clyde Emerson	M. E.	*West Hanover*
Hawes, Arthur Raymond	Ch. E.	*Sudbury*
Herrick, Clifford Kendall	Ch. E.	*Somerville*
Hosmer, Merton Augustine Jewett	Ch. E.	*Concord Junction*
House, Lawrence Carleton	C. E.	*West Hanover*
Howe, Myron Allen	C. E.	*Framingham*
Hudson, Elisha Sears	Ch. E.	*Jamaica Plain*
Hyde, Russell Noyes	M. E.	*Swampscott*
Jackson, Joseph Arthur	E. E.	*Auburndale*
Jenkins, Edgar Maitland	Ch. E.	*Bradford Vt.*
Jordan, Wendell Franklin	M. E.	*Peabody*
Keith, James Burrell	Ch. E.	*Elmwood*
Kendall, George Herbert	Ch. E.	*Newburyport*
Kennedy, Edwin Carey	Ch. E.	*Dorchester*
Kennedy, Henry Leo	M. E.	*Medfield*
Kenney, Cornelius John	C. E.	*South Boston*
Kerr, Arthur James	Ch. E.	*Everett*
Knowlton, James Adams	C. E.	*Melrose*
Krone, Lester Frederick	Ch. E.	*Boston*
Lambert, Harold Paine	Ch. E.	*Malden*
Lawrence, John Richard	M. E.	*West Groton*
Leach, Frank Percy	E. E.	*Phippsburg, Me.*
Levine, Philip	C. E.	*Chelsea*
Littlefield, Brewster Eben	C. E.	*South Boston*
Locke, Richard Bruster	C. E.	*South Boston*
Luce, Willis Chaffee	Ch. E.	*Vineyard Haven*
Madigan, Leo William	C. E.	*Harvard*
Manning, Arthur Lionel	M. E.	*Holliston*
Martell, Charles Sigsbee	E. E.	*Medford*
Mathews, Roger Emery	C. E.	*Cambridge*
Mayo, Isaac Adelbert	C. E.	*Dorchester*
McComb, Willis Lenard	Ch. E.	*North Chelmsford*
McCullough, Samuel	E. E.	*Weston*
McKay, George Houghton	C. E.	*Dorchester*
McLeish, John Rule	C. E.	*South Boston*
McLeod, John Gustave, Jr.	Ch. E.	*Dorchester*
Meagher, John Joseph	C. E.	*East Chelmsford*
Metzger, William Luther	C. E.	*Boston*
Mills, Kenneth Newman	E. E.	*So. Manchester, Conn.*
Mitchell, Charles Francis	C. E.	*Roslindale*
Munt, George Endicott	E. E.	*Whitinsville*
Naimon, Benjamin	C. E.	*Holliston*
Nelson, Thomas Eustice	C. E.	*Sharon*
Nicholls, Raymond Frank	E. E.	*Williamsburgh*
Nickerson, Edgar Watson	E. E.	*Beverly*
Nutting, Gerry Bradley	M. E.	*Pepperell*
Oliver, John Roger	M. E.	*Medfield*
Olson, Frederick Follett	M. E.	*Boston*
Otterson, Jonas Bernard	C. E.	*Framingham*
Parker, Benjamin	C. E.	*Weston*
Payne, Harry James	Ch. E.	*Revere*
Pelley, Ralph Wellington	E. E.	*Lynn*
Pierce, John Franklin	C. E.	*Medford*
Piper, Maurice Wise	Ch. E.	*Marlborough*
Plunkett, Ralph Augustine	C. E.	*Dorchester*
Porter, Roland Guyer	E. E.	*Beverly*

Name	Course	Home Address
Preble, Edwin Gay	E. E.	*Beverly*
Preble, Russell Adelbert	E. E.	*Merrimac*
Preston, Hiram Wentworth	E. E.	*Beverly*
Privas, Hyman Samuel	Ch. E.	*East Boston*
Purinton, Cyrus Leslie	E. E.	*Bowdoinham, Me.*
Reed, Edward Hazen	M. E.	*Woodstock, Vt.*
Rich, Karle Marshall	C. E.	*East Watertown*
Richardson, Edward Manning	C. F.	*Salem*
Richardson, Elmer Hanley	C. E.	*Reading*
Richardson, George John Leonard	E. E.	*Dorchester*
Robbins, Percy Allerton	Ch. E.	*Elmwood*
Robinson, Dexter Tupper	E. E.	*Roslindale*
Sargent, Shaw Dearborn	E. E.	*Newburyport*
Seavey, Herbert Thornton, Jr.	E. E.	*Stoughton*
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Smith, Clinton Allan	M. E.	*Plaistow, N. H.*
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Smith, Neil Sprague	Ch. E.	*Dennisport*
Smithies, Arthur Earle	E. E.	*Chester*
Spector, Aaron	C. E.	*Malden*
Stark, Robert William	C. E.	*South Boston*
Steele, Everette Vernon	Ch. E.	*Marblehead*
Stensrud, Clarence Bodien	C. E.	*Beverly*
Switzer, Byron Randlett	C. E.	*East Boston*
Taylor, Arthur Raymond	Ch. E.	*Framingham*
Taylor, Ralph Sheridan	E. E.	*West Somerville*
Thomas, Norman Sylvanus	M. E.	*Lewiston, Me.*
Thompson, Edward Henry	C. E.	*Norwood*
Thompson, Oscar Frederick	C. E.	*Norwood*
Toomey, John William	E. E.	*Pride's Crossing*
Trachtenberg, Harry	C. E.	*Roxbury*
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Viles, Jesse Sumner	E. E.	*Weston*
Vitalini, Walter Ramus	M. E.	*Milford*
Waldie, Thomas George	E. E.	*Beverly*
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Wheeler, Clifford Earl	Ch. E.	*Malden*
Wheeler, William Silver, Jr.	Ch. E.	*Dorchester*
Willard, Leslie Merriman	C. E.	*Malden*
Young, Harold Cushman	Ch. E.	*Westboro*
Zwisler, Perry Frederick	M. E.	*Willimansett*

C. E.—Civil Engineering Course; E. E.—Electrical Engineering Course; M. E.—Mechanical Engineering Course; Ch. E.—Chemical Engineering Course.

THE CO-OPERATIVE SCHOOL OF ENGINEERING

Boston Young Men's Christian Association

Boston, Mass..............................19

To the Dean:

I,.., *hereby respectfully apply for admission to the*..........................*Engineering Course of the Co-operative School of Engineering for the school year* 19   19   , *and submit the following statement:*

Name in Full...

Residence...*City, or Town*

State.. *Tel*................

Date of Birth...*Age*...............

Parent's (father's) name...

"   "   *address* ....

Graduate of........................*High School. Year*...............

If not a graduate, how many years were you in High School?...............*When did you leave?*............................

Why did you leave?...

Name of principal..

If employed since graduation, what is name of employer? ....

Employer's address...

Names and addresses of two other persons, not ministers, to whom we may direct inquiries concerning you. (*Give former employers, if possible.*)............................

....

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....

Do you plan to complete the full four years' course?......

Do you wish employment with a co-operating firm?......

When do you wish to start practical work?..................

Where will you live during the school-year?..................

Weight.................................. *Height*..............................

Have you any physical infirmities?...............................

Is your general health good, fair, or poor?....................

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REMARKS

General Departments

Boston Young Men's Christian Association

Department of Recreation and Health

Albert E. Garland, M.D., B.P.E., Director

This Department offers the *best recreation* that *re-creates.* Privileges as follows: Three Gymnasiums, Swimming Tank of Filtered Salt Water, Baths of all kinds, Classes to Music, Six Bowling Alleys, Tennis—Indoor and Out, Handball, Squash, Indoor Golf, Athletics—Indoor and Out, Basket-ball and Games, Boxing, Wrestling and Fencing. Best of Instruction. Medical Direction. Come in any time.

Department of Religious Work

A. B. Nicholls, Secretary

In order that young men may secure a well-balanced development and attain the true foundation for successful living, the Association advises each member to so plan his schedule that he may enter into one or more of the following activities:

Character Building Classes
Young Men's Sunday Forum
Gospel Team
Personal Interviews
Training for Christian Service
Lectures and "Talks"
Workers' Library
Twenty-four-hour-a-day Club

Department of Social Work

David M. Claghorn, Director

The attention of members is called to the many opportunities in the Association for social service, and the following social features:

A Newly Equipped Game Room
The Association Congress
Popular Social Evenings
El Club Sarmiento (Pan-American Club)
The Camera Club
Concerts and Entertainments

Department of Council and Placement

Frederick W. Robinson, Director

Advice given to young men concerning their vocational future and efforts made to place them in positions best adapted to their varied abilities. It also acts as a clearing house for young men seeking work and employers desiring to engage reliable help. Its service is not limited to members, but the latter are given liberal discounts and effort is made to notify them when good positions are open.

Boys' Division

James G. Barnes, S.B., City Boys' Work Secretary

The Boys' Division comprises boys from twelve to eighteen years of age, whose needs are studied and whose problems we try to solve. Activities are conducted along social, physical, educational, and spiritual lines. The annual membership fee is $2.00; gymnasium and natatorium privileges are open to the boys at special rates.

THE
CO-OPERATIVE
SCHOOL OF
ENGINEERING

FOUNDED FOR THE INSTRUCTION
OF YOUTH IN THE THEORY AND
PRACTICE OF ENGINEERING